March 1952 Vol 13 No 12

Editorial

THE sudden death of His Majesty King George VI came as one of radio's most dramatic and poignant experiences. The King's failing health had led us all to fear the worst, but few were prepared for it when it came.

Many of us were listening to the proceedings from Parliament House Canberra when, with incredulous awareness, we realized that something was wrong. The adjournment of the House, and the announcement by the Prime Minister which followed, was something which few who heard it will soon forget.

In the hours immediately following, as the news filtered through to the nation, millions all over the world stayed listening to hear just how this sad event had come about, slowly absorbing the shock which was at the same time a tribute to the impact the King's life had made upon all of us.

I wonder how many, during those few hours, marvelled as I did at the extent of the radio net-work spreading the sad news in an ever increasing tide, until it is safe to say that very few stations on the face of the globe failed to pass it on.

Those who had not heard the news over the air on the previous night found the story with pictures in the newspapers next morning. In the hours of darkness these pictures followed the news, again by radio, to receive a coverage almost as great as the spoken word itself.

Throughout the 10 days which preceded and included the King's burial at Windsor, radio and radio-picture services told the story to the world on a scale unprecedented in history. On the final day, the story of the long procession was broadcast through a virtual maze of short wave services repeating the program from the BBC, and translating it into other languages for the benefit of distant parts of the Empire, and of other nations who shared in our sorrowful tributes to the King.

The BBC, upon which the full weight of the sudden demand fell heavily, performed its task with the greatest efficiency and reverence. Portions of the broadcasts were almost overpowering. During a description of the procession to Windsor, the weeping of those near the announcer was heard quite clearly. One particularly poignant moment was the playing of the "Flowers of the Forest" by a pipe band as the Royal train drew out of the station. The funeral service itself was heard more clearly through the BBC short wave station than it was by many of those present in the Chapel.

It is estimated that 10,000,000 people witnessed the procession by television, five times as many as those who lined the streets. Radio brought to that vast gathering a more intimate picture of the scene than any except a few of those who took part in it.

It is a sad aspect of the passing of Kings that one Sovereign can only succeed another in the normal way through the death of one near and dear. For that reason alone, the Empire now looks forward to a new and happier coverage when our new Queen is crowned some time in the future.

This time we will not be faced with the same problem of sad urgency. By the magic of radio Queen Elizabeth II will be crowned in the presence of the largest audience the world has ever seen.

John Moyle

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RADIO AND HOBBIES IN AUSTRALIA

A NATIONAL MAGAZINE OF RADIO, HOBBIES AND POPULAR SCIENCE

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OUR COVER PICTURE

Jewels and pivots for meter bearings must be accurately checked, and here we see an instrument-maker at the University Graham Instrument Co., using a binocular microscope to check a pivot point for radius and polish.

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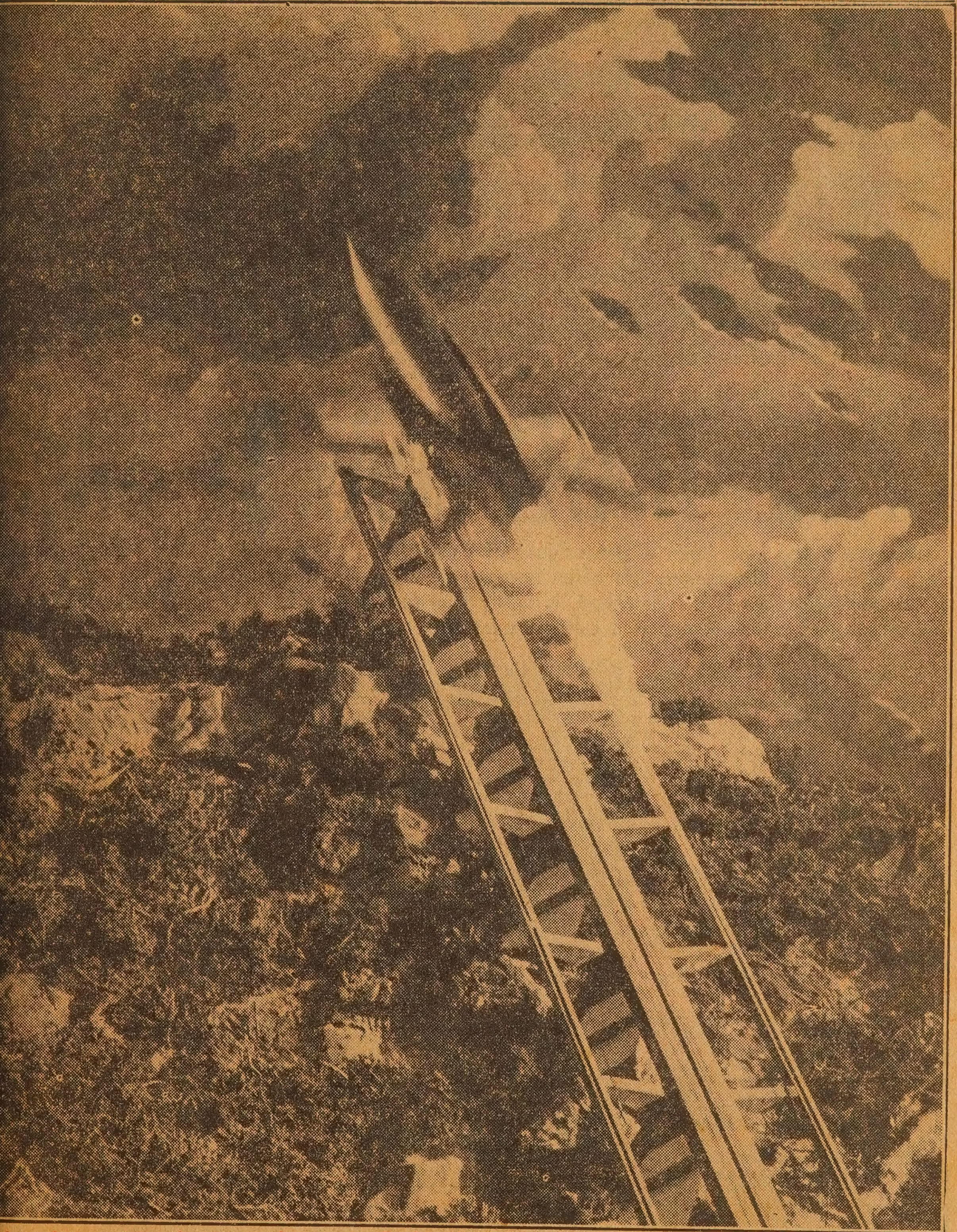
LITERALLY "OUT OF THIS WORLD"



Launching an inter-planetary rocket, as visualised in the Paramount picture "When Worlds Collide." The first orbital space craft will doubtless be remotely controlled and patterned, like this one, on current military high-altitude rockets. (See following pages.)

From the George Pal production, Destination Moon, this scene envisages the landing of the first men on the moon. Note th
the sky looks black because the moon lacks an atmosphere.

SPACE TRAVEL NOW IN SIGH

Because it has long been a pet subject of scientific fiction—and fantasy—ideas about travel between the planets are often completely discounted. Nevertheless, the science of "Astronautics," as it is now called, is firmly founded and we have in our hands equipment and knowledge which may well culminate in the construction of an inter-planetary vehicle.

By F. J. Camm

FOR many, it is within living memory that scornful views were held about the sister science of aeronautics, about radio, and certainly about television. Yet television is a far more remarkable achievement than the construction of a device for travelling to other worlds. There is no scientific reason why after a process of gradual development and evolution a space ship should not be successful.

We know a great deal today about travelling through the air, into the Heavyside Layer, the troposphere, and the regions beyond. As with every other scientific development the invention is forecast many years before it reaches practical development.

MISSING LINK?

Often it is because of some missing link; in the case of the motor car it was the internal-combusion engine. The past 50 years have been more remarkable in scientific developments. Each new discovery or invention improves existing devices. Thus radar, radio and television have made flying safe

With all this knowldege in a number of unrelated directions at our command it only requires a co-ordinating effort to apply it in new directions. The raw materials for space travel have been produced, and they now require unification.

Space travel is no longer Vernesque. Its evolution will be a gradual affair. The space ship will not be a sudden invention. The Wright brothers did not invent the aeroplane although they were the first to try a power-driven machine. They made use of and co-ordinated the knowledge which had been gained by dozens of individual experimenters.

The subject is now being studied very closely, as was apparent from the recent International Congress on Astronautics which took place in London during September, and at which a number of scientists of International repute gave their ideas as to how the spaceship should be constructed.

It was generally agreed that the rocket affords the means, the only one so far known of realising the dreams of Jules Verne and H. G. Wells. It is now well known that a rocket is more efficient in the vacuum of outer space and at high flight speeds than it is within the atmosphere.

Another great advantage is that it can generate enormous power for little weight and size of engine. The power/weight ratio cannot be equalled by any other form of mot power.

The V2 used by the Germans d ing the war, for example, was f times as powerful as the *Qu Elizabeth*.

In World War II, Germany m great use of rocket engineering. day it is being actively developed over the world for assisting take-off of aircraft, for the prop sion of aircraft at extreme sp and heights (the American Bell rocket plane was the first to fly f ter than sound, and its successors intended to fly at several thous mph and altitudes of hundreds thousands of feet); for offensive defensive missiles, likely eventua to supersede military aircraft as know it today; and for high-altit research by instrument-carrying p jectiles.

PRESENT FIGURES

An American example of the lat has already climbed to a height 250 miles at a speed of 5000 m This experimental work, althou unrelated to interplanetary flight, contributing data for its event achievement as is current resea on atomic energy.

The space ship of the future v undoubtedly make use of the lat It is more than probable that wit the next 20 years rocket engineer will have advanced to a stage wh it is possible to establish an Ear satellite-vehicle in a stable c orbit around the Earth, and this v be the first step to the conquer of space.

Once the Earth-satellite-vehicle has been established flights by piloted rockets several thousands of miles into space will follow.

There will be flights circumnavigating the Moon without landing on its surface, first by robot projectiles carrying television and later by piloted craft, flights to the Moon by piloted space ships landing tail first on its airless surface using the braking effect of their rocket jets, then taking off again and returning to Earth, where a safe landing may be made by using wind within the atmosphere.

There will also be flights to other planets of the Sun's family. First to Mars and Venus because they are nearest. A century or more hence no doubt the planets of other suns—the distant stars—will be visited.

THE MOMENT BEFORE TAKE-OFF

Another scene from Destination Moon showing the crew a moment before the take-off. As the rocket fires, the terrific acceleration forces them back hard into the padded couches.

Many involved technical problems, however, need to be solved before that is possible.

When the Great Adventure commences depends entirely on the funds and the facilities made available for the task. But astronautical engineers expect the first piloted return flight to the Moon to take place before the end of the present century. It could happen sooner if a concerted attack were made on the problem, such as the effort which is being made in connection with the atom-bomb.

The theme of the technical sessions of the Second International Congress on Astronautics was the Earth-satellite-vehicle, or orbital rocket, because this represents the first great objective on the way to interplanetary flight.

BEING STUDIED

The American Government has already announced that it is seriously studying the Earth-satellite-vehicle, which has many practical uses, both for military and civil purposes. The first artificial satellite to be established will undoubtedly be nothing more than a small radio-controlled rocket carrying automatic instruments for research purposes, capable of sending its readings back to earth by radio.

Piloted rocket craft will follow later; they could leave their circular orbits at will, by reducing speed with rocket jets firing in the direction of motion, and land back on Earth using wings like normal aircraft.

The principle of the Earth satellite is very simple. A good analogy may be obtained by tying a stone to a piece of string and whirling it around in a circle. The stone keeps traveling in the circle because the inward tension in the string balances the *outward* centrifugal force produced by the stone's motion.

In exactly the same way a body circling the Earth at the right speed would remain at a constant distance, in a state of equilibrium. This time the outward centrifugal force would be balanced by the invisible, but very powerful, pull of gravity.

The nearer the satellite to the Earth, the more rapidly it would have to move to maintain itself. Just outside the atmosphere, a few hundred miles up, the required speed is about 18,000 mph.

Moreover, once the satellite had been given its initial speed it could never lose it again, since there is no air-resistance. It could never fall down—any more than does the Moon, which stays in its orbit for exactly the same reason.

Thus a rocket guided into the correct circular path around the Earth could shut off its motors once it had reached the required speed and remain orbiting the Earth for ever in perfect safety. The satellite could be established at any distance, but for technical reasons it would be easier to place it as near the Earth as possible—as long, of course, as it was outside the atmosphere and thus immune to air-resistance.

The value of such orbital rockets would be:—

(a) As research observatories beyond the atmosphere, for physicists and astronomers. (Study of cosmic ray primaries, and astronomical observation without hindrance from our semi-opaque atmosphere, &c.).

(b) As observatories for meteorologists, who could "see" the Earth's weather system developing, and thus make more accurate forecasts.

(c) As radio relay stations, capable of receiving short-wave signals from the Earth's surface and rebroadcasting them to reach around the curvature of the surface. This would permit world-wide reception of television, or "frequency-modulated" radio; also the radio guidance of military missiles over longer ranges.

(d) As military bases for reconnaissance or even for launching projectiles.

Half-way to the moon, a space traveller stands on shell of rocket and gazes back at the receding earth. Magnetised soles hold him onto surface and there is no atmosphere to sweep him away. Note pressurised suit, and radio for communication. (From Destination Moon).

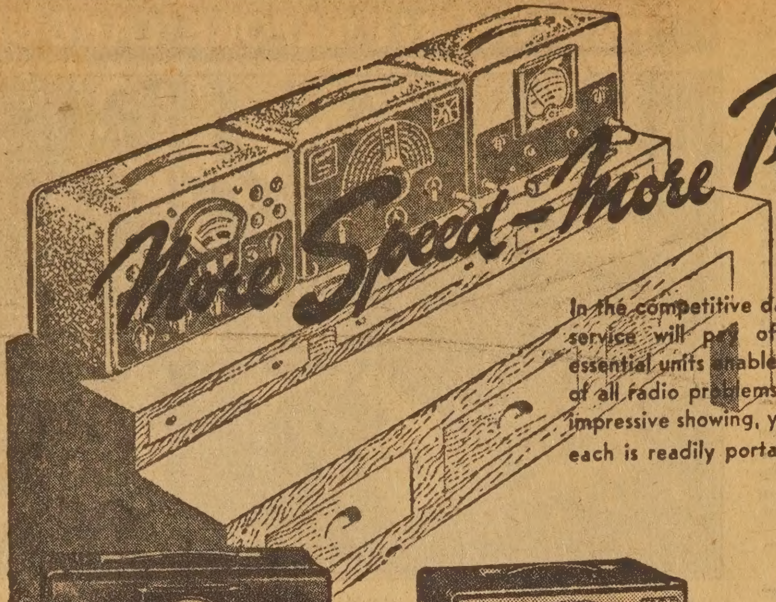
MANNED SHIP

Eventually, a large manned "space-station" might be constructed from components ferried out to the required orbit by rocket craft. Space ships might also be refuelled, while waiting in such orbits, from tanker rockets climbing up from the Earth's surface to meet them.

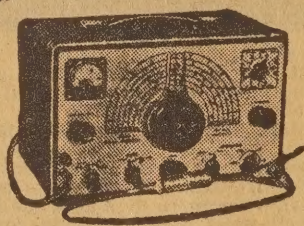
Both these seemingly fantastic developments would be practicable, because any object, once established in the orbit, would have the effects on it of both gravity and velocity balanced out; it would have no apparent weight, and would "float" in space. Connection between one rocket and another, in a circular orbit in which both were "Earth-satellites," would also be entirely feasible. Although both would be moving at tremendous speeds, their *relative* velocity would be zero.

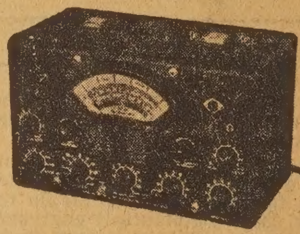
It is the value of these orbital techniques in connection with refuelling future space ships which makes them so interesting and important for interplanetary flight, apart from the fact that the practical uses of orbital rockets, in themselves, afford a powerful reason for obtaining support for astronautics in the early stages of the subject.

More Speed-More Profit . . .



In the competitive days ahead, better and quicker service will pay off—handsomely. These three essential units enable quick and effective diagnosis of all radio problems . . . combined they make an impressive showing, yet, individually self-contained, each is readily portable for outside service.





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Capable of quickly locating most obscure and elusive of intermittent, noisy, open or short circuits. Checks all component parts and tests for high resistance insulation leaks.

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Detachable co-axial leads, 20 page instruction book supplied. Employs 4 valves.

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Modulation: Internal—400 cps. variable 0-100%. External — Uniform response with 1db from 30 to 10,000 cycles, 2 volts required for 30% modulation, 5 volts 400 cycles signal available externally with less than 2% distortion. Frequency modulation negligible.

Leakage: Less than 0.5, microvolt at 30 Mc/s., decreasing at lower frequencies. Triple shielding incorporated.

Attenuator: Ladder type of unique construction with 10 ohm nominal impedance on all but the highest output ranges. Attenuator has negligible effect on carrier frequency.

Valves: 2-6SN7; 1-1852; 1-6X5. Dimensions of case: 14 ins. x 8¾ ins. x 8¼ ins. Weight: 29lbs. Available for 220-260 volt A.C. and external vibrator operation.

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Mr. L. R. Shepherd, PhD., in his lecture before the British Interplanetary Society, said that it is now generally agreed that the requirements of a vehicle, making a non-refuelling return-flight to the Moon or other planets, are too severe to be met by existing methods of propulsion. However, if one could accumulate sufficient fuel and materials in a close orbit about the Earth, it would be possibe to proceed from there to the surface of the Moon and back.

The attainment of a circular orbit at a height of 500 kilometres above the Earth's surface would not prove too difficult. A three-step rocket with an exhaust velocity of 3 km/sec., an effective mass-ratio of less than 50, and a ratio to initial mass of payload of c300 should be capable of achieving this orbit.

This performance is not outside the range of present techniques. However, we should need to do better before proceeling on to the next stage of interplanetary flight, otherwise we should be forced to carry out a "lift" involving hundreds of flights by satellite vehicles before we had accumulated sufficient materials in the orbit.

Improvements would be required, both in the performance of the satellite vehicle and in the subsequent interplanetary vessel in order to bring the project down to a reasonable economic level.

Improvements in the satellite vehicle might be achieved with chemical propellants or might lie in the application of nuclear energy. In the case of the inter-orbital vehicle, however, one might go to a new principle, making use of very high exhaust velocities at very low accelerations.

This could be done in an "ion-rocket," employing a propulsive jet consisting of a beam of electrically-accelerated ions. Such a vehicle would not be capable of landing on the surfaces of planets, but would be capable of executing large velocity changes with low mass-ratios, operating exclusively between satellite stations — for example, between an Earth-satellite and the tiny Martian moons, Deimos and Phobos.

TYPES OF VEHICLE

Space-flight might therefore be carried out in two types of vehicle, viz., satellite vehicles having low exhaust velocity and high thrust operating from surface to orbit, and interplanetary space ships having high exhaust velocity but very low acceleration operating between orbits.

Permanent orbiting space-stations might be included in this scheme to act as the junctions between the two types of vehicle, but they would not be essential to the scheme.

Space-stations and ion-rockets might draw propellants and other massive materials from bases on small satellites or the asteroids to avoid having to lift these through large gravitational potentials.

The aerodynamics of a space rocket must take into consideration the fact that during its operation flight in four different regions is necessary — the subsonic, the transonic, the supersonic, and the conditions encountered at great heights. Different laws of flow apply to each of these four regions, which complicates the aerodynamic design.

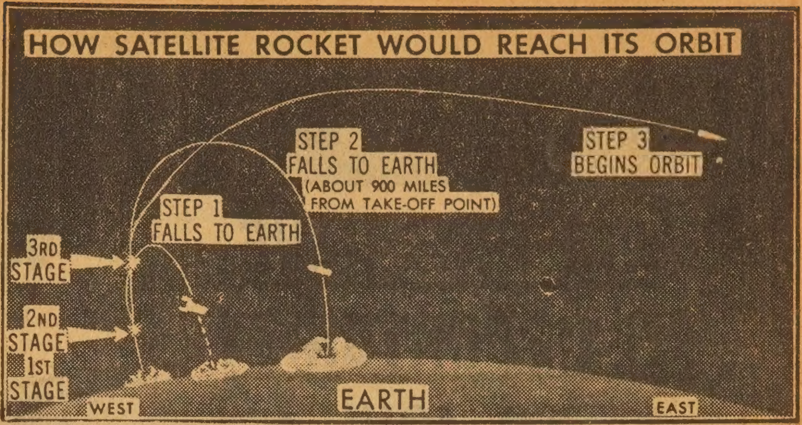
For the subsonic the drag is largely determined by the body fineness ratio and smoothness; as the transonic is entered, there is a sharp rise in drag coefficient (up to 10 times the low-speed value), and accurate lift calculations can be made by the Ackeret-Busemann method.

Bodies with ogival nose shape and thin, wedge-shaped aerofoils are best. Swept-back wings are advantageous between M=0.8 and 1.2, but the rocket will not operate long in this region. Straight wings should therefore probably be used, unless the landing glide dictates otherwise, which is doubtful.

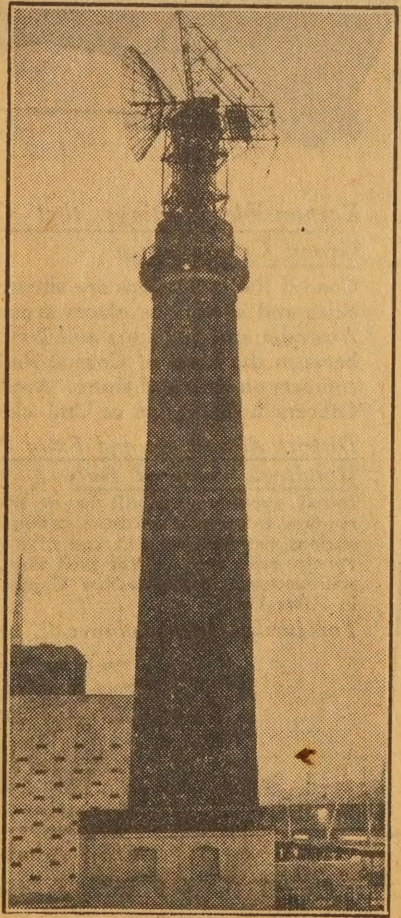
In the supersonic, Newton's laws, derived from the collision of particles with an inelastic body, govern the lift and drag. Flat-plate aerofoils are theoretically best, though for constructional reasons wedge-sections should again be used; aerodynamically, this regime is not far removed from the transonic.

At great heights drag coefficients rise again, but the dynamic pressure will be negligible in practice, hence the aerodynamic forces will be so very small that they are even considered useless for initial braking prior to landing.

Below 50 kilometres, however, lift/drag ratios of 6 to 8 are considered attainable for landing manoeuvres using aerodynamic braking. It is thought that fears of excessive aerodynamic heating are groundless.



A three-stage rocket would seem necessary at present to produce an earth satellite. Owing to low gravitation, current type rockets could be launched easily from the moon to bombard the earth's surface.



Within the past two or three years, radio signals have frequently been sent to and reflected from the moon. Here London's ancient shot tower provides a mount for a radar-to-the-moon demonstration.

NOT FAR DISTANT

During take-off, the maximum total resistance will occur at a height of 8 to 10 kilometres, where the flight Mach No. is about 1.5.

Thus it will be seen that the development of rocket propulsion and the application in the near future of atomic power to rockets has transformed the whole subject of astronautics from a scientific dream to an imminent reality. Ayone who attended the second four-day International Congress of Astronautics which took place in London in September of last year, where eminent scientists expressed the views which I have summarised here, could not have been left in any doubt about that.

Since the Wrights first flew on the 17th December, 1903, we have seen the speed of flight advance from 30 miles an hour to those well in excess of the speed of sound, and astronautics is at the present time in a state comparable to that of aviation in the days of the pioneers. There is now little doubt that space travel will be realised before the century closes.

The increasing membership of the British Interplanetary Society is an indication of the growing interest. Like all new industries and sciences, lack of finance is the retarding force which prevents more rapid development. Experiments are costly, and they have to be financed privately. Perhaps a Carnegie or a Nuffield will arrive and fund a project to build the first experimental spaceship.

THEY MEASURE IN MILLIONTHS

A millionth part of an inch (0.000025 millimetres) may sound like something too small to be of particular value in the world. Obviously scientists will need to use such fine measurements, but ordinary people may wonder how it is possible for such a tiny fraction to influence engineers.

AS soon as engineers, however, begin to work in thousandths of in inch—and they frequently do—they need gauges of even greater accuracy

To make the gauges accurate to a 10-thousandth part of an inch (.0025 millimetres) (which is what they must be), there must be other gauges having the same relation to the engineer's gauge has to the work it controls. That means that the gauge for making the engineer's gauge must be accurate to about one-hundredth thousandth part of an inch (.0025 millimetres).

ACCURATE GAUGES

Obviously, too, there must be somewhere gauges to measure the accuracy of the hundredth-thousandth of an inch gauge. That is where the millionth of an inch comes in. For it is upon such a minute measurement that the one-thousandth of an inch (.025 millimetres) fairly commonly used by engineers, depends.

In Britain gauges which are accurate to the sixth place of decimals are kept at the National Physical Laboratory at Teddington near London.

It was for this purpose of setting standards of accuracy in measurement, in mass, and in weight, that the National Physical Laboratory was set up just over 50 years ago.

Based upon the science of measurement (or metrology as it is called) is almost all the other work done at Teddington. This falls into three groups: long-term research; short-term investigation; and routine testing of a large range of instruments and apparatus.

50-YEAR STUDY

In almost every job it has undertaken the laboratory has found the need for measuring instruments. One of the first of its invesigations was into the properties of iron (an investigation that is still continuing). The laboratory has been producing purer and purer specimens of iron until recently, a purity of 99.997 was achieved.

Given that purity the iron was then made "dirty" again so that the properties of iron mixed with all kinds of other things could be accurately determined. Accurate measurements have been needed at every stage of that 50 years' investigation.

Another problem on which the laboratory has been working almost since its foundation is that of fluid flow. It began with the study of wind pressure on buildings, continued with the design of ships' hulls in water tanks, and went on with the study of aircraft in flight.

Fluid flow affects all these things. The flow of wind around buildings has led to the investigation of the design of the proposed new suspension bridges over the Rivers Severn and Forth; the study of ships' hulls has saved thousands of tons of coal by producing ships easier to propel through water; the study of the resistance of air to aircraft produced in 1912 the first completely stable heavier-than-air machine and is now continuing into the problems of flight at above the speed of sound.

In World War II, a supersonic wind tunnel at Teddington was used to test the probable limiting range of the German V-2 rocket before the rocket attack was launched against London.

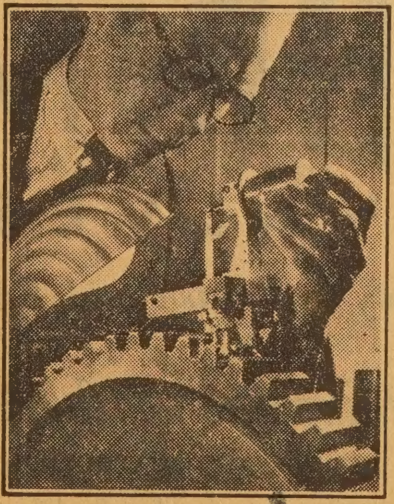
EARLY RADAR

Radar, too ,sprang from the work of the laboratory. Its discoverer, Sir Robert Watson Watt, was superintendent of the radio division until he left in 1936 to take charge of the experimental station of the Air Ministry in which radiolocation, as it was then called, was developed.

Research into screw threads was given fresh impetus because of the difference between United Kingdom and American threads. That research has continued until it reached the point recently when a specification for a Unified Screw Thread was published.

At every point of its work accurate measurement has been the basis of all progress at Teddington. The measurement of sound to help in acoustic problems; of light to help in lighting factories and homes—apart from the more acurate determination of the speed of light—of road surfaces to prevent skidding, of ventilation (including the new House of Commons), of the properties of building materials including heat resistance, of fatigue in metals.

Scientists and engineers of Britain's National Physical Laboratory inspect a model of the proposed suspension bridge over the River Severn in the west of England. The model, built in the Laboratory's wind tunnel, is mounted on a turntable so that it can be exposed to wind currents of varying speeds from all quarters.



This small hand guage being tested in Britain's National Physical Laboratory at Teddington, near London, measures the angular pitch between the successive teeth in a gear wheel.

FARMING BY REMOTE CONTROL

One man sitting in a control lorry can now plough six different fields at the same time, using six different tractors, none of them with a driver. The secret is wireless control, made many more times effective by radar developments during the war. How different from the methods we've been used to!

THIS picture of one man working six tractors is more than a vague possibility of the future. That it is practicable has been demonstrated in England by Major-General E. E. Tremlett, who commanded an AA division during the war.

It is, I believe, the first application of radio control to the farm, and it shows how far this system has developed since I demonstrated the first radio-controlled aeroplane on Salisbury Plain thirty years ago.

We are not likely to have many radio-controlled tractors in Britain in the near future, but these tests are signs of the coming revolution in farming.

SCIENCE ON FARM

The scientist is turning farmer, or, if you prefer it, the farmer is turning scientist, and in the next 50 years, we shall see the elimination of much of the monotonous and laborious work on the farms, work that for centuries has made the farm laborer prematurely old and often crippled.

In the last two centuries industry has been revolutionised. Engineers have not only replaced manpower with steam or electrical power, but have devised thousands of ways of eliminating human labor altogether, so that complex machines can largely control themselves.

But farming has remained almost unchanged. We have replaced horses by horsepower to a certain degree, but it remains a crude, dirty business, based on cheap and plentiful labor.

Today the labor is neither cheap nor plentiful—and is not likely to be again. The only way we can hope to supply the growing demands of the world for food is in the same way that we hope to supply its need for clothes, boots and a thousand other things. It is by making machines do the work and devising machines to look after machines!

"SLAVE" TRACTORS

Visitors to one district of Texas in recent years have sometimes been astonished to see three tractor ploughs following each other, neatly furrowing a huge field, and not a driver to be seen.

The secret here was not radio control, but a small mechanical device in front of each tractor making it follow the course of the previous furrow. The farmer-inventor has only to plough the first furrow round the field and then set the tractors going one after another for them to go on hour after hour, turning at the corners and stopping themselves automatically if anything goes wrong.

Three men are saved days of monotonous work by this method.

The idea can only be applied on very large, flat fields, and I quote it as an example of what can be done by applied science. In countries with comparatively small farms we may expect the development to be rather along the lines of radio control.

The farm of the distant future may have a "control" tower where the farmer will be able to sit in comfort in any weather, operating half a dozen different implements, perhaps of different kinds, at the same time. If anything goes wrong, the assistant engineer, as the farm "hand" will be called, will go to the machine on his caterpillar workshop and adjust it.

The workshop will probably carry a large portable shed, which can be erected in seconds over the machine so that repairs may be made under cover.

MORE COMFORT

I have always been appalled at the discomfort which those engaged in farm work are prepared to suffer. Long before we get full mechanical development the standard tractor will probably be a "saloon," and there is no reason why it should not have electric heating and a wireless to provide music while you work.

Forking loads of "muck," stacking sheaves, digging drains, hedging and ditching are all time and labor wasting.

There already exist power machines for performing the task in a fraction of the time required by human labor.

by Professor A. M. Low

Next season we shall again see an army of men and women engaged in picking up potatoes and lifting sugar beet. A single machine can replace them and dig, top and clean nearly 50 tons of beet a day. A "finder" grabs the top of the beet plant, a circular knife tops it at the same time as a digging blade scoops it up. Rollers with teeth clean off the mud and a short elevator lifts it on to the harvester.

These machines are already revolutionising the US beet industry. Used with flame-thrower weed-killers and machines for planting the seed at regular intervals, they have replaced armies of laborers who did the singling, hoeing and harvesting.

Engineers today can design a machine to perform any agricultural operation, however complicated it may seem. The cotton picking and cultivating machines are having far-reaching political and economic effects in the south of the US. They even have machines like giant vacuum cleaners which pick nuts!

Great changes will take place with the development of the aeroplane as a farm implement. Where farms are large, the aeroplane will be extensively used for such purposes as sowing, or distributing insecticide.

The farmer's great enemy is time. There come days when conditions are exactly right. They may stay right only for 24 or 48 hours. With hand labor he cannot hope to deal with more than a small fraction of his land in this time. By using helicopters he might sow a thousand acres in a day. Good weather is not yet within our control!

These are glimpses of things to come on the farm. The idea of making hay in our present crude way, entirely dependent on the weather, will, in 50 years' time, seem as fantastic a a car without a hood would be today. The grass will be gathered, artificially dried and stacked, saving not only labor, but the dreadful waste that occurs when the weather is unfavorable.

FORGET THE RAIN!

Uncertain weather can result in the value of a crop being halved in a week—and the weather is always uncertain!

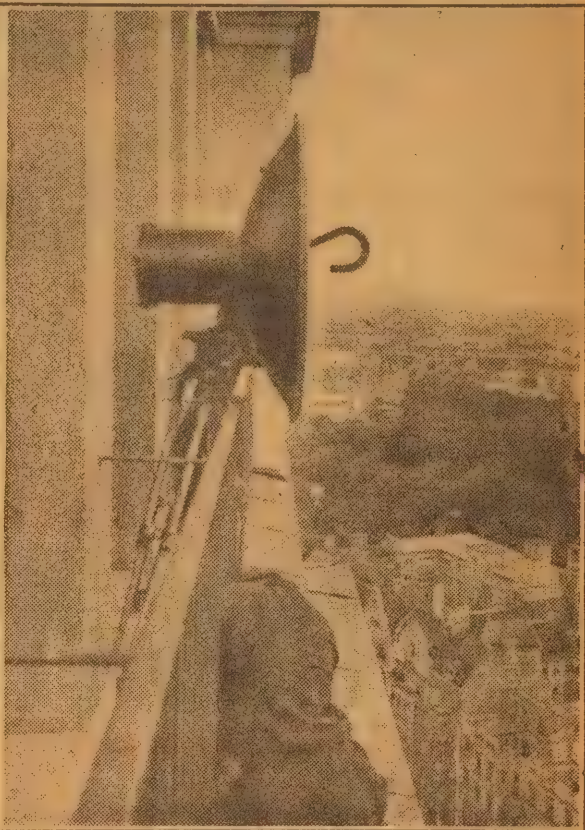
Instead of the clumsy business of cutting cereals and storing them in ricks until the thresher is available the "combine" will be universally used, with artificial grain driers overcoming the damp when required. There will be machines to pick, shell and clean peas before delivering them to the canning or quick-freezing factory—probably at the end of the field.

There will be machines to plant strawberries, tomatoes and lettuce. Many such machines are already at work, planting cabbages at the rate of 200 a minute, spacing them exactly and giving them a squirt of water to help them on the way.

The chemist and biologist will play a big part in the farming revolution. We have glimpses of things to come in collective weed killers that destroy weeds, but leave crops untouched, in artificial insemination, making it possible to breed thousands of pedigree animals from one bull, in the production of higher yielding strains of plants and animals. By-products of atomic fission may have some startling effects on farming.

GERMANS SHOWN U.S. TELEVISION

This bat-wing transmitting antenna erected atop of West Berlin's City Hall, gave German residents their first glimpse of American television. The station operated on the US channel 4.



One of the two microwave relay units used in the Berlin telecasts was mounted on the side of the City Hall tower, one of the highest points in the area. Cable links were also employed.

To emphasise, doubtless some of the scientific resources of the "decadent" democracies, American authorities recently staged in West Berlin a large-scale public demonstration of modern television. Thousands of residents witnessed the demonstration on a large open-air screen and over a hundred domestic receivers disposed round the city.

THE equipment, which was supplied by RCA, included a complete broadcast station, 110 home receivers, two theatre projectors with 15 x 20ft screens and all necessary aerial equipment. It was packed in 401 cases and weighed in all some 35 tons.

The whole lot was shipped to Rotterdam, then taken by train across France and Germany to West Berlin itself. Here, however, the erection crew found it impossible to make an immediate start on erection because preparations for the Communist Youth Festival in the Eastern sector had tied up most of the available trucks.

When transport did finally arrive, the crew were left exactly 85 hours to instal the complete system, if the demonstrations were to take place on schedule.

In that time, however, a complete 500-watt station was erected in the heart of the city—actually atop the City Hall. An outdoor studio was set up in Schoenberg-Stadt Park and an indoor studio in the Titania Palace, West Berlin's largest theatre. Even then, the work was delayed by rain and by the fact that two microwave links and a camera had been damaged in transit, along with other gear.

The park studio was anything but elaborate, consisting of a stage 40 x 75ft, with canvas roof and draped on three sides. A separate canvas section housed the auxiliary control equipment. This "studio" was used to originate both live and film programs.

For the first telecast, 16 home-type receivers were set up around the park and the remainder distributed around the city in stores, halls and public places. The audience of 25.000 around the park receivers proved far beyond their capacity and a projection equipment was added.

The second projector was set up in the Potsdamer Platz, only 200 yards from the main crossing to the Russian sector. Whether by accident or design, however, the Russians held a large fireworks display, with magnesium flares and showers of rockets. While these occasionally blacked out the screen, the mixed audience of east and west Berliners hardly appreciated their efforts.

The program continued for two weeks, showing for four hours each evening.

A typical program would lead off with a 15-minute film, followed by variety acts including gymnasts, jugglers, vocalists, orchestral groups and comedians. The scene would then shift to the Titania for a short play, a symphony orchestra or a fashion show, then back to the Park studio for another film, a dance and act and more music.

The symbol for signing on and off was a reproduction of West Berlin's Freedom Bell, with a Marshall Plan sign superimposed. Reception throughout the whole area was excellent and the response of the public to the demonstrations indicated the keenest possible interest.

Soap is one of the most glamorised and highly commercialised products of this modern age. Vide Greer Garson and her bubble bath. Some of the newer detergents are difficult to produce in attractive form.

moulds to bring it to the desired shape.

Soap has for a long time been unique by possessing characteristic properties not shared by thousands of other materials.

Firstly, it is a detergent. This is merely another way of stating that it cleans.

Secondly, it has a wetting action. That is to say that it assists water to spread over surfaces.

Pure water tends to collect in tiny drops on a surface, but a soap solution will spread.

Soap solutions will penetrate fabrics faster than will water alone.

Then soap has an ability to disperse solids, liquids and gases in water so much that they are difficult of separation.

WHAT SOAP DOES

Soap thus has characteristics which can be summarised by saying that it is a detergent, a wetting agent, a penetrating, an emulsifier and a disperser.

All these characteristics are due to what chemists call "surface activity." The surfaces of the soap solution, the oil drop, the cloth fibre, the particles of dirt or the sheet of glass, &c, are all involved.

THEY CLEAN BETTER THAN SOAP

Soap, that very useful agent, seems to have reached the end of its long history as the only substance capable of carrying out the functions of cleansing. Other products are being developed which can be employed under conditions where soap is completely useless.

FOR many centuries man has used soap to cleanse himself and his clothes. The use of this substance was mentioned by the Roman writer Pliney, in the first century AD. He places it as a Gallic invention and, at that time, it seems to have been mostly used for brightening up the hair.

Prior to that time, people annointed themselves with oil and the juices of plants. Whether they ever got rid of these afterwards, is a matter for conjecture.

Fuller's earth was extensively used in the attempt. This is a white substance found in various parts of the world as a natural deposit. Subsequently, a handful of sand might have been useful as an abrasive for removing the more stubborn deposits of olive oil and Fuller's earth, &c.

HARD WORK

In those early days, the process of ablution was one which required considerable effort and thought, and it remained so until soap came into universal use after about 1791.

This was the year in which Leblanc discovered the sodium process for making soap. A great boost was given to the industry and, in 1823, a more scientific approach was made when the French chemist Chevreul proved that fats are combinations of fatty acids such as olein, stearin and palmitin, with glycerine. Further, that the action of saponification depends on the exchange of the metal in the alkali for the glycerine in the fat.

In soap making, the fats are boiled in an alkaline solution of caustic soda. The fats break up into their component parts of fatty acid and glycerine and the fatty acids combine with the sodium alkali. This is called "saponification" and the result is soap.

Glycerine is a by-product of soap making and settles to the bottom of the vats where it is drawn off. It is a very valuable substance.

Of course, all kinds of purification processes are carried out before the soap is fit for use. There must be no free caustic soda in the soap, as this is very irritating to the skin.

It may take some weeks before the soap is ready for the market.

The mixture must be beaten with large paddles to render it smooth and workable. It is then cast into

by Calvin Walters

What really happens is that the disinclination of the separate substances to mix is broken down.

This is exhibited in the wetting and penetrating ability of soap where the disinclination of two entirely different substances such as water solution and textile fibre to mix is broken down and these two substances come together as it were.

In its cleansing process, soap solution wets both the surface of the fabric and the surfaces of the drop of oil or dirt adhering to it. It is as though a wedge of water was driven between the two, thus preventing them from adhering together.

OIL AND AIR

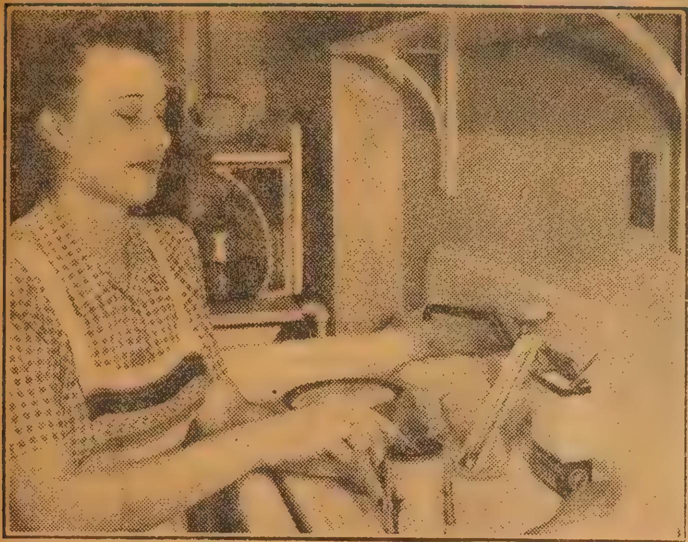
The same thing takes place in emulsification where the drops of oil and the air bubbles are prevented from mixing by the thin film of soap solution surrounding them.

Now soap has certain limitations and two of its shortcomings are serious. These are its inability to do its work in the presence of acids and its ineffectiveness in places where the water is "hard."

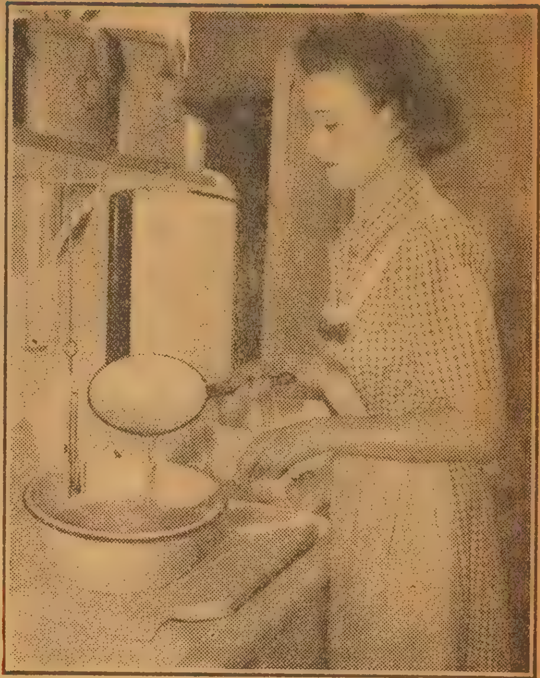
Hard water is water in which there is an excess of calcium salts or magnesium.

In acid solutions soap is converted into fatty acids which have no detergent powers whatsoever and are insoluble in water. Thus soap

A STORY IN PICTURES—MAKING YOUR OWN SOAP



Six pounds of fat is needed. Clean by boiling in water and skimming off when cool. Obtain a can of lye (caustic soda) and pour into 2½ pints of water. Let this mixture cool. (Lye when mixed with water heats up.) But, while cooling, add two tablespoons of borax. Use only enamel or iron pans, as lye will discolor aluminium. Then assemble as part of your equipment a wooden spoon, a thermometer and a measuring cup.



Let the lye-water cool to room temperature. Melt the fat and reduce it to about 100 degrees F. If you can hold your hand in it it is the right temperature. Now pour the lye-water into the fat while stirring slowly. Pouring the lye too fast or stirring too vigorously may cause the fat and lye to separate. Keep stirring the mixture until it begins to thicken. It should take about 15 minutes. Discard can and wash utensils carefully. Caustic soda is highly corrosive.

When the soap mixture thickens, pour it into a mould which may be a wooden or cardboard box, about 12in x 15in x 5in deep, which should be lined with a dampened piece of white cloth. Prepare the mould before mixing the lye and fat. After pouring the soap, cover the mould with a blanket or piece of carpet and store it in a warm, dry place for 24 hours.

After the home-made soap has set for 24 hours, remove it from the mould by lifting out the cloth and cut it into desired sizes. Stack the pieces in a cupboard, out of a draft. It can be used immediately upon withdrawal from the mould but it will harden and improve if aged for 10 days or more.

is useless in industrial processes where acids are used.

In hard water soap reacts with the calcium or magnesium salts to form the familiar greasy curds which are responsible for the ring around the bath tub.

When it became necessary during the war to find something to do the washing when fat was in short supply for the manufacture of soap the Germans discovered synthetic detergent solutions.

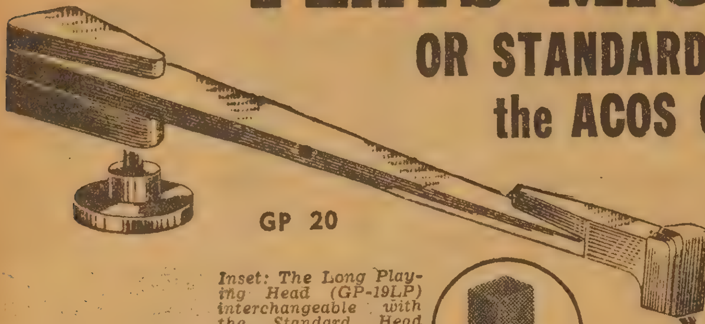
These are now in universal use and have been the means of overcoming the difficulties associated with ordinary soap as outlined above.

The first thing that had to be done was to find the form of the molecule of soap.

PLAYS MICROGROOVE

OR STANDARD RECORDINGS

the ACOS G.P.20 Microcell Pickup



GP 20

Inset: The Long Playing Head (GP-19LP) interchangeable with the Standard Head (GP-19).

The G.P.20 pickup is designed for use with the standard 78 r.p.m. records or the 33 1/3 or 45 r.p.m. long-playing microgroove records. To meet these differing requirements, two interchangeable slide-on heads are available.

G.P.19 head supplied as standard.

G.P.19 L.P. head available for microgroove.

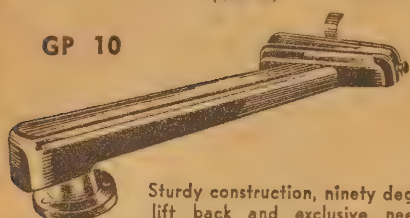
It is something new in pickup design and has 20 times greater output than comparable magnetic types, while needle talk and motor rumble are practically non-existent —permanent sapphire stylus—wide frequency response.

Price—G.P.20 complete with standard head £6/3/6

Price—G.P.19 L.P. head £3/11/0.

Price—G.P.19 standard head £3/11/0.

GP 10



Sturdy construction, ninety degree lift back and exclusive needle pressure adjustment makes this a really outstanding unit in the field of pickups. Has a low harmonic distortion, with an average output of 1.5 volts.

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Cartridge only (G.P.9) Price 36/9

G.P.11 Acos Pickup Cartridge incorporates permanent sapphire stylus. Replacement cartridge for ACOS G.P. 12 pickup and many American types. Useful frequency range 25 to 12,000 c.p.s.

Needle pressure only ½oz. 41/6

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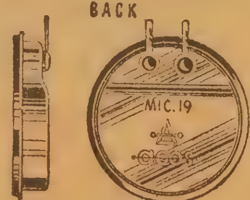
BACK



MIC 19

MIC 19 Sintercel fulfils the requirement for a flat insert with good sensitivity and a frequency response 40/8000 c/s. Unaffected by vibration, exceptionally robust construction. Price £2/19/9.

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This was found to consist of a long chain of hydrogen and carbon atoms ending in a group of carbon, oxygen and sodium atoms. The first group is called a hydrocarbon group and the second a sodium carboxylate group. The first synethetic detergent appeared on the market before the war in 1930. It is called sodium dodecyl sulphate. It has a slight difference to the soap molecule. Its tail ends consists of a group composed of sulphur, oxygen and sodium atoms. That is the only difference in the molecule—there is sulphur instead of carbon in the tail.

Because of this it has a cleansing action equal to that of soap and in addition it is effective in acid solutions or hard water.

There are three main groups of detergent molecules. The anionic, the cationic and the non ionic.

This, of course, needs some explanation.

When water is added to soap or to other detergent solutions, the action of dissovling serves to split the molecules of the detergents into two electrically charged parts or ions.

These two parts have opposite charges and which part will be positive and which negative depends on the structure of the molecule.

In anionic detergents it is the negatively charged portion that is the detergent. Soap and the abovementioned sodium dodecyl are anionic.

In cationic detergents it is the cation or positively chaged part that is detergent.

The non-ionic detergents do not ionize but act as whole electrically charged units.

It is mostly the anionic detergents that are widely used today because they act well and are cheap to produce.

GERMICIDAL

The cationic detergents are much more expensive but they have a valuable property in that they are germicidal.

The non-ionic detergents are comparatively new to the market but are proving of great value. They have one serious disadvantage, however, in that they are so far only producable as thick, viscous liquids which are not attractive. Endeavors have been made with some success to produce these as powder or flakes.

The action of a detergent is most interesting.

The hydrocarbon chain in the molecule is hydrophobic. This means that it has a distinct aversion to water. It is water hating.

The rest of the chain is hydrophilic or water loving. It wants to get as near to the water as possible. It is these characteristics to which is due the surface activity mentioned earlier.

All soaps and detergent agents are soluable in water for the purpose of removing greasy dirt from solid surfaces such as glass, metal or fabric.

The process of cleansing involves firstly the adequate wetting of the surface and the dirt, secondly the removal of the dirt and finally the holding of the dirt in a suspension which will prevent it from being redeposited.

As explained earlier a detergent solution acts as a wetting agent. It has been found that the new synthetic detergents are so thorough in this respect that, if a duck is immersed in such a solution, the air in the oily feathers is so effectively removed that the duck has great difficulty in remaining afloat.

The molecules on the surface of the water would rather be in contact with air or the water than with any greasy substance. This, of course, stops the water from wetting a greasy surface evenly and it forms droplets with a minimum of area contacting the water and grease.

Detergent solutions on the other hand have those portions of their molecules at the surface which have a greater affinity for grease than air. Thus the hydrophobic section of the detergent molecule attaches itself to the greasy soil and a bridge is formed between the dirt and the water.

HYDROPHILIC

The other end of the detergent molecule which is hydrophilic or water loving of course attaches itself to the water and this joins the bridge between water and dirt. The dirt can now be removed by agitation and it remains to prevent the dirt from re-depositing. In other words the dirt must be kept in suspension.

How a detergent solution keeps the dirt in suspension is at present largely a matter of conjecture but one theory explains it as follows.

"The ions or molecules of the detergent are absorbed on the surface between the solution and a particle of greasy material. The hydrophilic (water hating) portions of the molecules are pointed toward the greasy particle while the charged hydrophilic portions are pointed away from it. The dirt particles are thus covered with a charged layer of detergent molecules. Other particles of dirt in the solution are surrounded by the same charged layer and since for any given detergent the charge around the particles will have the same sign the particles mutually repel one another. It is this process that is presumed to keep the dirt from settling." (Kushner and Hoffman.)

In contrast to detergent solutions, which are usually made from petroleum compounds, there is another substance group which, though not a detergent in the regular sense, has nevertheless detergent and several other desirable properties.

I refer to "quartenary ammonium compounds."

This sounds a formidable term but it simply refers to the arrangement of the atoms.

In ammonium compounds like ammonium nitrate, the nitrogen atom is surrounded by four hydrogen atoms. In quartenary ammonium compounds these four hydroden atoms have been replaced by organic carbon-containing groups.

All salts have two portions — a cation with a positive charge and an anion with a negative charge.

In soap and most of the other detergents the detergent property resides in the anion or negative portion but in quartenary ammonium compounds the property resides in the positive group. Thus while soap and the quartenaries have something in common as a detergent they are, chemically speaking, opposite.

Aside from being detergent the quartenaries have remarkable germicidal properties.

BY COMPARISON

Phenol or carbolic acid has long been the favorite germicide against which other disinfectants are compared. One of the quartenaries is 600 times more powerful than carbolic. Concentrations as low as one part in 50,000 are effective.

Another advantage of these new substances are that they are mostly odorless, colorless, non-irritating and non poisonous in the concentrations usually used. They are non volatile and not affected by heat. Thus they can be used for washing utensils used for food, as in a dairy, and they have even been used on food itself as a preservative.

(Continued on Page 106)

FIRST SQUADRON OF JET BOMBERS

Taken recently at the Binbrook RAF Station, this picture shows a line-up of Canberra jet bombers belonging to 101 Squadron—the first to be equipped with these planes. Canberra jets are being manufactured locally for the RAAF.

The WARBURTON FRANKI Page

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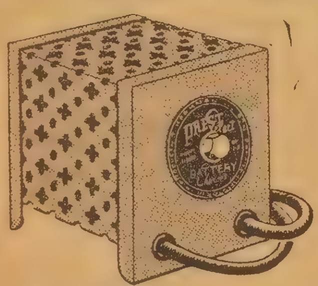

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NEW CHAMBER MAKES WEATHER TO ORDER

All the world's weather is now available in a single room 14 feet square and 10 feet high in the testing laboratory of the RCA Engineering Products Department in Camden. NJ.

WITH this 50-ton chamber, recently installed for the testing of all kinds of electronic equipment under conditions to which it may be exposed in use, laboratory personnel can simulate all temperatures, humidity levels, and other climatic and atmospheric conditions found on or above the earth to an altitude of 70,000 feet above sea level.

Here, every device made by RCA for military or civilian use in faraway places, from aeroplane transmitters to walkie-talkies, can be proved under conditions prevailing in the Sahara or Siberia, in the jungles of the South Pacific or atop the Himalayas.

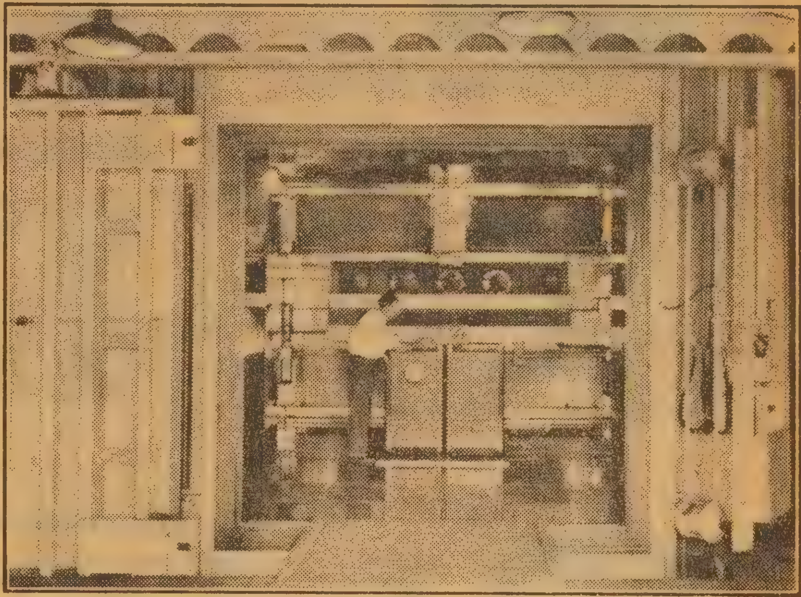
Known as a "stratosphere chamber," it can reduce atmospheric pressure to the level encountered at an altitude of 70,000 feet, which is higher than the accepted altitude record for heavier-than-air craft and almost as high as man has ascended in a balloon. The partial vacuum produced is sufficient to reduce a 29-inch column of mercury to one inch.

HOT AND COLD

Heating and refrigeration equipment within the chamber can create temperatures from 185 degrees F.—more than 50 degrees higher than the highest natural temperature ever recorded on the earth's surface—to minus 85 degrees F—within a few degrees of the lowest natural temperature earth-bound instruments have recorded. To provide refrigeration for the unit required 180 horsepower, enough to run 720 average size domestic refrigerators simultaneously.

Humidity within the chamber can range from a heavy fog to almost complete lack of moisture.

Because of its size and weight, the chamber, which cost 150,000 dollars, posed a number of instalaltion problems. It was built in three sections and transported from Newark, NJ, to Camden by trailer-truck. Because the chamber overhung the trailer three feet on each side, creating a traffic hazard, special approval from the State Highway Department was necessary, and the trip was made in the early hours of the morning, when traffic was light. The three sections weighed 11, 17, and 21 tons, respectively. In order to get them into the laboratory, a wall area measuring 18 by 20 feet had to be removed from the building.



A standards engineer prepares electronic equipment for test in RCA's new "stratosphere chamber," which can simulate any climatic or atmospheric condition.

The door of the chamber weighs about two tons, and is moved into place on rollers fixed at the top of the chamber. To obtain a perfect seal, an air cylinder is fixed on each corner of the door to exert the required pressure. An inner wall of 9-inch-thick insulation is used to maintain temperatures.

STUDIOS RECORD STRANGE SOUNDS

QUITE apart from the production of routine music and speech recordings, the RCA Victor studios have been called upon to record many unexpected sounds for equally unexpected uses.

A Connecticut resident was annoyed by a flock of starlings under the eaves of his home. All else failing to discourage their visits, he had a disc made of the hostile hoots of an owl. Each time the starlings paid a visit, the record came out and was played full bore—allegedly with the desired results.

Out in Hollywood, a film star was most anxious to discourage visits from local tomcats. Her order was for a record of a furiously barking dog.

There was even the case of a shy Romeo, who recorded his proposal and had the disc sent to his intended!

Along more constructive lines, special records have been made of whines and warble tones, which have been used to treat hearing deficiencies. Certain disorders of the ear, including deafness in parts of the spectrum have yielded to treatment of this type.

Most bizarre recordings of all include the sounds of certain beetles chewing leaves and the much-amplified footfalls of a fly walking on the wall.

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0-3	0-6 mA	0-15	50-2250-100,000 ohms.
0-15	0-30 mA	0-150	x 500-22,500-1 megohm.
0-150	0-150 mA	0-300	x 5000-225,000-10 Megohms.
0-300	0-1.5 Amps	0-600	
0-600			x with external battery.

Fitted with large direct reading meter with illuminated dial and OVERLOAD PROTECTION. Tests over 2000 American English and Continental valves including latest types. Filament volts range from 1.1 volts to 117 volts. Filament continuity and element shorts shown directly on meter. Cathode leakage read in megohms. The instrument is housed in a solid oak carrying case and supplied with comprehensive instruction manual. Also available as valve tester minus multitester ranges—Model 45 A-S.

PRICE £41/15/- Plus Sales Tax

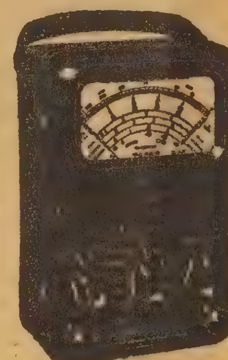
IMMEDIATE DELIVERY

MODEL 75A

RANGES 20,000 ohms per volt A.C.—D.C.

D.C. Volts	A.C. Volts	A.C.-D.C. Current	Decibels	Resistance
0—0.1	0—1	0—50 uA	—30 to —5	1—50—10,000 ohms
0—2.5	0—2.5	0—5 mA	—22 to +3	1000—50,000—10 Megohms
0—10	0—10	0—50 mA	—10 to +15	*10,000—500,000—100 Megohms
0—50	0—50	0—500 mA	+4 to +29	
0—250	0—250	0—5 Amps	+18 to +43	*With external battery.
0—1000	0—1000		+30 to +55	

This is a robust 20,000 ohms per volt 50 range universal multimeter designed for accuracy and stability. Fitted into an attractive case, the meter is provided with instantaneous OVERLOAD PROTECTION. The clear, easy to read scale has a length of 4 inches. An internal buzzer is provided for quick continuity tests. Complete with test leads.



PRICE £19/17/6 Plus Sales Tax

MODEL 120A POCKET MULTIMETER

RANGES 1000 ohms per volt A.C.—D.C.

D.C. Volts	D.C. mA	A.C. Volts	Resistance
0—0.25	0—1	0—10	0.5—20—2000 ohms
0—10	0—10	0—50	50—2000—200,000 ohms
0—50	0—50	0—250	*500—20,000—2 Megohms
0—250	0—500	0—500	*5000—200,000—20 Megohms
0—500		0—1000	
0—1000		0—2500	*With external battery.
0—2500			

This is an accurate pocket size instrument using a robust, sensitive meter movement fitted with instantaneous OVERLOAD PROTECTION and is housed in a high grade moulded case. All resistors used for voltage and current ranges are adjusted to an accuracy of 1%. Supplied complete with test leads.

PRICE £10/10/- Plus Sales Tax

DIMENSIONS: $4\frac{1}{2}$" x $3\frac{1}{4}$" x 2"

Australian Distributors:

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Sales and Showrooms, 277 Clarence Street, Sydney.

Taylor Best for TEST EQUIPMENT

SA: GERARD & GOODMAN LTD., 192-196 Rundle St., Adelaide.
Queensland: CHANDLERS PTY. LTD., Cnr. Albert & Charlotte Sts., Brisbane.
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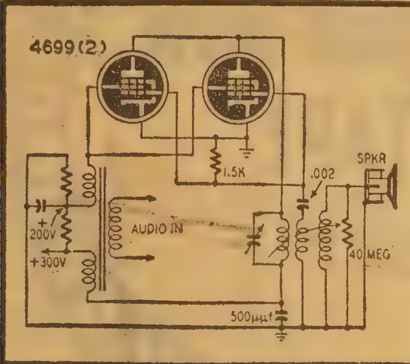
Manufactured by:—TAYLOR ELECTRICAL INSTRUMENTS LTD., GREAT BRITAIN

MORE ABOUT THE "IONOPHONE" LOUDSPEAKER

Following the recent announcement of the French "Ionophone"—a loudspeaker which is energised purely by atmospheric ion movement—it is now claimed that the current model is equivalent to a conventional 10-watt speaker and shows an acoustic efficiency of 7 percent.

AS explained in the last issue of Radio and Hobbies, the unit consists essentially of a small quartz horn with a hot platinum wire in the narrow end, and with a surrounding metal cylinder. An intense electrostatic and high frequency field between the wire and the outer shell produces a condition of ion emission and agitation. This induces atmospheric heating and expansion, with consequent pressure waves.



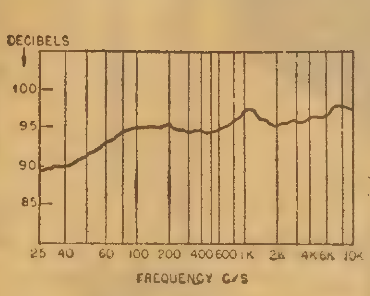


Figure 1, on the left, shows the Ionophone driving circuit while figure 2 (right) indicates the response curve of the speaker.

For the speaker to operate, the high frequency field must be suitably modulated, so that the driving force for the speaker is not pure audio but a modulated RF envelope.

The high-frequency, high-voltage oscillator used to excite the speaker, and which can be modulated by a low frequency, is shown in Fig. 1. A form of plate modulation is used. Grid modulation could just as well have been used, or any of the standard modulation systems.

We thus have a small transmitter of classical design except for the output, which is fed to the speaker through a high-ratio RF transformer, to obtain the necessary high voltage. The 40-meg. resistor in shunt with the secondary of the transformer serves to damp out peaks.

It is made of a small plastic rod, with a diameter of about 3-8 of an inch, and is about 8 inches long.

The power produced by the prototype here described is equal to that of an electrodynamic speaker rated at around 10 watts. The response curve (Fig. 2), which is the result of tests made by the Centre National d'Etudes des Telecommunications, shows its wide range.

As a matter of fact, it can reach much higher frequencies. However, its output diminishes in the supersonic range because the transit time of the ions becomes an appreciable quantity in relation to the oscillation cycle.

Its acoustic output (the relation of the low-frequency electrical energy and the acoustical energy measured in a soundproof room), is 7 pc—much higher than the better type of present electrodynamic loudspeakers.

The special characteristics of this new loudspeaker suggest interesting possibilities. Though it can be used in conjunction with present-day radio receivers without any modification, it may be predicted that the future will see sets specially adapted to the new loudspeaker.

Receivers may even be designed without a detection stage, but with the intermediate frequencies, adequately amplified, serving as the source of excitation for the loudspeaker. Elimination of the detector stage, which is a source of distortion, would be a great advantage.

At the same time, a special oscillator as a source of high-frequency excitation for the speaker would no longer be needed as the modulated IF and would fit the specifications exactly. However, there are certain difficulties to be overcome before such a receiver can be created.

Aside from use in the radio, an interesting application of the ionic loudspeaker might be made in the field of supersonics.

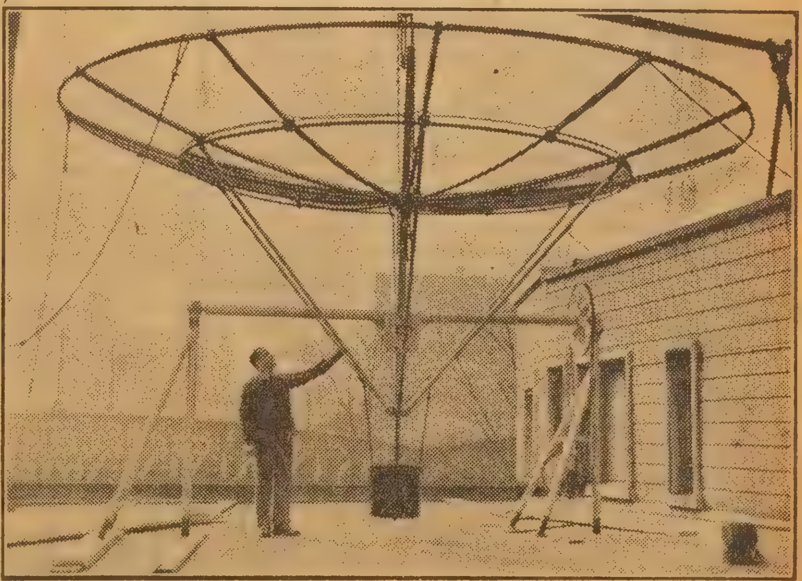
Of all the known supersonic transducers (piezoelectric, magnetostrictive, &c.), it is the only one that is a periodic and which can with equal ease generate all the supersonic frequencies and frequency-modulate them.

Like all other loudspeakers, the ionic model can be used also as a microphone. Sound waves penetrating to the vicinity of the cathode disturb the movement of the ions and thus modify the electrical resistance of the ionised space.

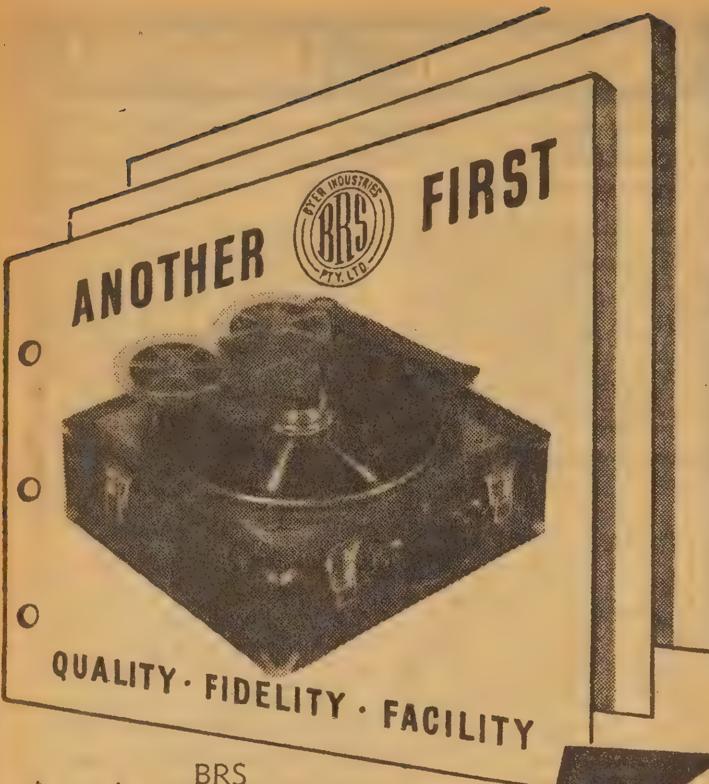
However, it is not safe at present to predict the practical realisation of such a microphone, as the background noises due to the irregular flow of the ions—hardly perceptible when the device is operating as a loudspeaker—would act the same in a microphone.

The possibility of simultaneously producing supersonics of controllable frequencies and intense ultraviolet rays modulated by the same frequency might be of great value. Meanwhile researchers have before them a new and fertile field of investigation.

PARABOLIC AERIAL PROBES SUN



Khartoum was directly in the path of a solar eclipse on February 25 and both optical and radio equipment was installed to investigate the temperature of the sun's outer atmosphere. This special parabolic radio antenna, designed by French engineers from La Radio Astronomie will accurately track the sun's path. Note the driving mechanism at the right. (By courtesy of the French Embassy, Canberra).



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Loads 600' tape on standard 5" reels.
Thirty-five minutes playing time.
True constant speed.
Wide range frequency response.
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No expensive drive motors.
Direct coupling to turntable.
Unique tape drive eliminates tape threading.
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Hinges on telescopic rear mounting posts.
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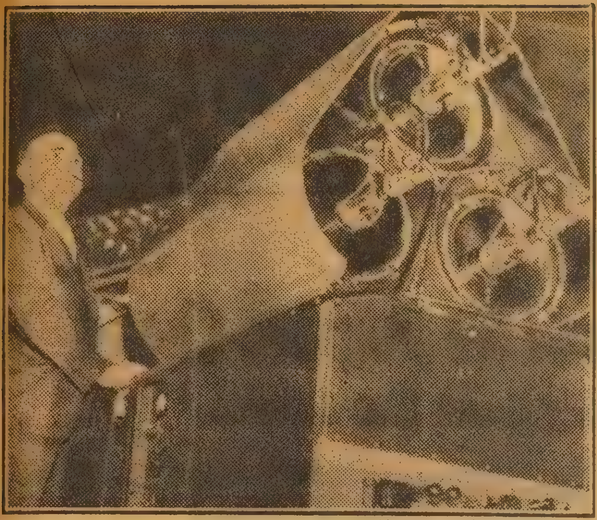
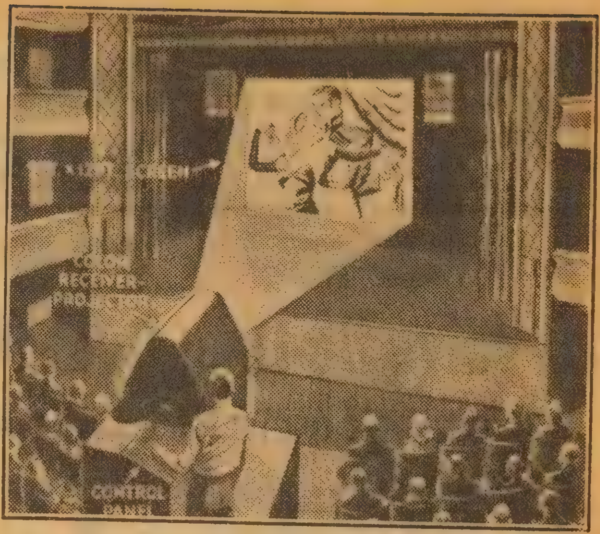


Dr. David Epstein at the controls of the tricolor projector which provided theatre-sized screen images during the recent field tests in New York.



Showing how the tricolor projector complete with its control panel was installed in the auditorium of the Colonial theatre, New York.

RCA PUSHING ON WITH ELECTRONIC TV

As a climax to its recent field tests with compatable, all-electronic color TV, the Radio Corporation of America presented a four-day demonstration of theatre-size color TV in New York. Quality of the pictures was said to be excellent by representatives of the Press and theatre who witnessed the demonstrations.

WHILE the theatre demonstrations were in progress, domestic type color receivers were disposed around the city for public viewing, while the programs were also available over a regular channel for black-and-white reception on ordinary home receivers.

The same programs were sent by coaxial line and microwave relay to Washington, to demonstrate the adaptability of the system to existing relay facilities.

Both studio and outside broadcasts were included, one particular outdoor broadcast coinciding with heavy rain. Protected only by tarpaulins, the cameras continued to operate and produced quite brilliant color images.

The projector used for the theatre demonstrations was a modified three-in-one version of the television projectors which are currently operating in monochrome in several American theatres.

FIVE DISTINCT TYPES

Three powerful 5in kinescopes are used in the projector, each with a differently colored phosphor. A triple lens system blends the three images into a single full-color picture. Though installed in the auditorium, RCA claim that there is no reason why similar equipment should not now be built to project pictures up to 18ft x 24ft from theatre balconies.

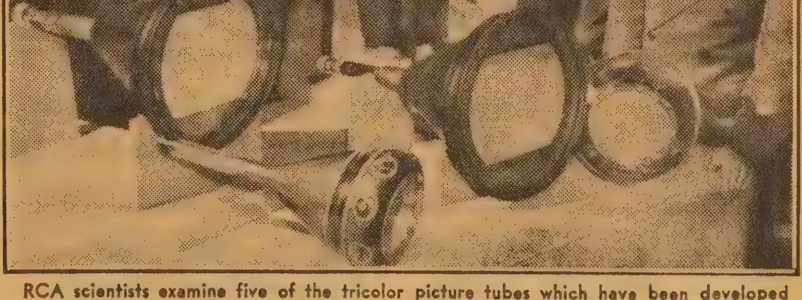
Meanwhile, on the domestic front, RCA research workers reveal that they have designed and built no fewer than five distinct types of color picture tubes. Though the color dot tube has received most attention, other composite color screens were tested using line and checker-board patterns.

Another tube had the screen at an angle of 45 degrees to the axis of the beam, which was deflected to strike the right color phosphor just before reaching the screen. Grid control of the beam was also tried in other tubes as a means of color control.

The color tube which is now in pilot production at the Lancaster tube plant is a three-gun type, along lines which have been explained. It uses a pattern of 600,000 phosphor dots — red, green and blue — each .014in diameter and arranged in a series of triangles. A mask behind the dots allows the respective beams to hit the appropriate color dot at each instant.

The tube can be used either for the RCA electronic dot-sequential system or the Columbia line sequential system.

By way of interest, the RCA "Line-screen color kinescope" now revealed for the first time, would appear to be very similar in principle to the Lawrence color tube mentioned recently in these columns. The screen carries alternate lines of color.



RCA scientists examine five of the tricolor picture tubes which have been developed in the company's laboratories. Dr. V. K. Zworykin, on the extreme right, recently visited Australia.

NEWS AND VIEWS OF THE MONTH

Out-door Symphonies

THE number of people who attend outdoor symphony concerts must encourage those hardworking members of the ABC who stage them, but it is extremely doubtful whether listeners enjoy them over the air. The high cost of hearing performances in a concert hall has probably a great deal to do with it, and a free performance amplified by public address systems (which were never intended to broadcast music) is no doubt better than none at all.

The listener's reactions aren't quite that way. He is used to hearing quite good broadcasts from the hall during the concert season, and very much better recorded broadcasts at other times. It is hard to believe that many lovers of good music can bear to listen to the unpleasant confusion of sound which inevitably results from an open air orchestral broadcast.

We do not think it is legitimate to assume that when a costly orchestra has a performance, even in the open air, it is logical to use it for a program. Programs should be chosen with due regard to minimum standards, and by no shadow of imagination can some of the recent open-air efforts be considered up to the mark.

The same criticism can be levelled at more than one such broadcast we have heard from country concerts. The orchestra has to work under some difficulty in many of these country halls, and the engineer responsible for the broadcast is no happier. Transmission line troubles frequently add their shortcomings, not only in the way of interruptions, but in poor quality and extraneous noises.

Let us not deny pleasure to those who like to hear the orchestra under blue skies, or who have no other opportunity to do so. But if they are willing to put up with severe musical limitations in the process, these should not be forced upon the listener, who, sooner or later, turns to another program in self-defence.

The ABC would do well to make a special effort in this, and similar matters dealing with the technical quality of their star programs. Until the advent of the LP record, a good studio or concert hall broadcast was perhaps the most satisfying of all programs via the loudspeaker, for, although some good 78 records were superior in frequency response, they still had a high surface noise and needed constant changing.

A well reproduced LP symphony record can be heard with no surface noise at all, and much better response and "presence" than any broadcasts except, perhaps, the best studio efforts heard with a wide-range tuner.

To be fair, this is a problem not confined to the ABC by any means, or for that matter to Australian stations. Quite recently one of our English contemporaries was taking the BBC to task much more severely. It's true, too, that some of the land-line problems, for instance, aren't easy to overcome. The "circumstances beyond our control" approach might be a good let-out, but it's no solution. It certainly isn't an excuse merely to do one's best and leave it at that.

Broadcasting is up against a really serious competitor in the LP record. Right now its miles behind, and the position will become more acute as records and equipment improve. Poor, open-air broadcasts don't help to increase the reputation of local orchestral broadcasts.

POPULAR SCIENCE QUIZ

Q. Electro-plating is quite a familiar treatment of certain articles but what is a simple explanation of the process?

A. As the term implies, the process is carried out by electrolytic action or electrolysis. For example, with copper-plating, pure copper is used for the positive pole and the article being plated acts as the negative pole, each pole being immersed in a copper-sulphate solution with provision for making good electrical connection to them.

A source of current (DC) is applied to the poles, positive to the positive pole of the electrolyte bath and the negative to the article being treated.

The passage of current through the solution causes the positive copper ions to move to the negative pole where they are deposited as a particle of copper. The negative sulphate ions are attracted to the positive pole. The whole process results in the article attached to the negative pole being coated with copper. The time taken for this process depends naturally upon the amount of current passing through the solution the surface area of the article and the thickness of the plating desired.

The same principle is involved for nickel-plating, cadium-plating and such like, except that, in the main, a different solution and positive pole composition is used in the bath. For instance, nickel-plating, a nickel-sulphate solution is used with a positive pole of sheet or rod nickel. Of course, the deposited nickel surface must be "buffed" to give it its characteristic shine!

Q. What causes a rainbow to appear?

A. Most of us are familiar with the circumstances under which a rainbow is most likely to be seen. Its formation is due to the breaking-up or dispersion of rays of sunlight into their component colors by passage through raindrops.

This phenomenon can be explained in this way. When a ray of light passes from one medium to another, it is bent or deviated by an amount depending upon its wavelength and the refractive index. The shorter the wavelength, the greater the amount of deviation, for a given refractive index.

However, white light is composed of seven main colors, red, orange, yellow, green, blue, indigo, violet, each of which is of different wavelength. The red is the longest and the violet is the shortest in this visible spectrum. Now, n the case of sunlight passing from one medium, the air, into another medium, the water in the raindrops, we will see, if we are at a favorable angle with the point of deviation, these rays of sunlight in their component colors. The semicircular shape is merely a combination of points subtending the appropriate angles to the observer.

The seven colors will not necessarily be seen separately as some adjacent pairs will combine to produce a color of a wavelength somewhere in between the two. Generally speaking, the three primary colors, red, green, blue, will be seen with combinations of the other colors in between.

Q. What is the actual meaning of the color of a body?

A. As pointed out in the preceding answer, colors are light rays of different wavelength. We could say, of course, that the wavelength of a visible light ray determines its color.

When white light (i.e. containing all colors) falls upon an opaque body, the pigment or finish of the surface reflects more readily the light rays of a certain wavelength or certain narrow band of wavelengths. The rays of other wavelengths in the visible spectrum are absorbed. The result is that the body surface appears to be of a particular color. This action of the body surface is known as selective reflection.

Similarly, if a colored transparent body is held up to a source of white light, it will transmit or pass light rays of a certain wavelength according to the color of the body. This is selective absorption. One practical application of this is in the use of light filters in photography.

White surfaces reflect most of the incident light, grey surfaces about half, the other half being absorbed, black surfaces about 10 pc, the remainder being absorbed.

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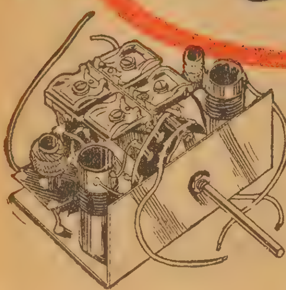


K1 KIT

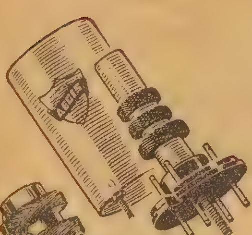
K1. A dual wave assembly incorporating permeability tuning aerial and osc. coils for B/C (550 1600 Kc) and S/W (7-23 Mc.) Trimmers and padder (fixed) condensers fitted. Iron core adjustment is made from above chassis (trimmers from beneath). Measurements: 2½" long, 3¾" wide, 1 7-8" high.

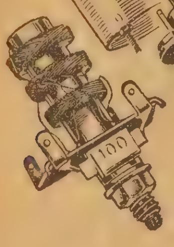
B/C COILS

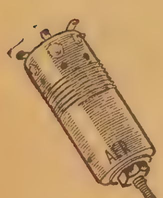
R.F.
M2 Aircore, Shielded.
M6 Permeability Tuned, Unshielded.
M10 Permeability Tuned, Shielded.
M15 Permeability Tuned, Shielded. WITH Reaction Winding.
M20 Aircore, Unshielded, Progressive Wound.

AERIAL
M1 Aircore, Shielded.
M5 Permeabiltiy Tuned, Unshielded.
M9 Permeability Tuned, Shielded.
M12 Aircore, Shielded with Reaction (Reinartz).
M12 Aircore, Unshielded, Progressive Wound.

OSCILLATOR
M3 Aircore Shielded.
M7 Permeability Tuned, Unshielded, 455 Kc. Converters ECH35, 6J', EK2, 1R5.
M11 Permeability Tuned, Shielded, 455 Kc. Suitable for same Converters as Type M7.
M11A Permeability Tuned, Shielded, 455 Kc. For 1A7 Converter.
M11B Permeability Tuned, Shielded, 455 Kc. For 6SA7 Converter.
M11C Permeability Tuned, Shielded, 175 Kc. Sutiable f orsame converters as Type M7.
M21 Aircore, Unshielded, Progressive Wound.







S/W COILS

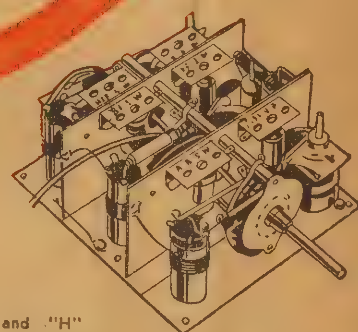
AERIAL
H1 Aircore.
H4 Permeability Tuned

R/F
H2 Aircore.
H5 Permeability Tuned.

OSCILLATOR
H3 Aircore, 455 Kcs.
H6 Permeability Tuned, 455 Kcs.
H6S Permeability Tuned, 455 Kcs.

Padder Value: All Coils .0035 mfd. fixed.

Note: S/W Coils are available for all frequencies up to and including 10 metres (30 Mc.).



K2 KIT

K2, A dual wave assembly with same coverage as K1 type and incorporating R.F. stage. All coils permeability tuned and matched for "AWA" and "H" gangs. Constructed on sub-chassis measuring 5 3-8" long, 2 7-8" high, 5½" wide.

Transformer I.F.'s

455 Kc

Type
J1 Aircore, No. 1.
J2 Aircore No. 2.
J9 Permeability Tuned, No. 1.
J10 Permeability Tuned, No. 2.
J13 Permeability Tuned, No. 1.
J20 Permeability Tuned, No. 1 and No. 2.
J21 Permeability Tuned, No. 3. (A medium selectivity group designed for the general purpose D/W receiver employing two stages of I.F. amplification. As gain is slightly reduced to ensure stability, it is essential that these units be used in sets of three. Band width is 4.5 Kcs. at 6DB and 20 Kcs. at 60DB. "Miller Effect" detuning is eliminated.

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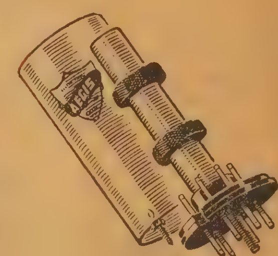
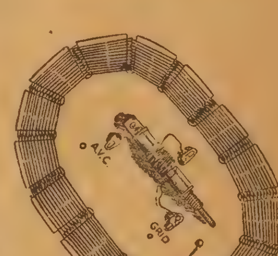


LOOP AERIALS

M17 Loop Aerial, wound on canvas bakelite former, oval in shape, measuring approx. 7¼" x 5". Windings terminated at centre with eyelet lungs. Coupling turn for external aerial provided. Matches A.W.A. and "H" Gangs.

M17A Loop Aerial, similar M17, but with loading coil for peak performance over entire band. Permeability tuned.



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Trip to the Moon

ELSEWHERE in the issue we feature an article by the well-known English writer F. J. Camm, in which he opines that we are fast approaching the time when space travel will become a reality.

In similar vein, Alexander De Seversky, the US aeronautical engineer, has recently predicted that explorers will be able to fly to the moon in 3½ hours at a speed of 140,000 mph—this in the year 2000.

In a recent speech at the Buffalo University, he stated that designs have already been developed for atomic-powered space ships for such a flight. "Only the power plants are still needed," he added.

While this may appear to be a fundamental lack, the world preoccupation with atomic research is so great that almost anything could happen in the next four or five years.

NEW EMPHASIS

With the large-scale atomic bomb an accomplished fact, a large weight of research is now directed toward the evolution of small-scale atomic weapons and of power plants which will not be cumbered with en enormous mass of shielding, &c. Indications are that British scientists, now headed for the Woomera range, have the first objective in sight, while it is inevitable that the second will also be achieved.

It has been said that if as much money were directed to solving the problem of space travel as to the perfection of atomic weapons, much might have been achieved already.

Actually the two projects are destined to merge. Immediately atomic power can be substituted in rockets for chemical propellants, attention will turn automatically to the evolution of virtually unlimited-range, remotedly-controlled vehicles to serve the present role of long range bombers.

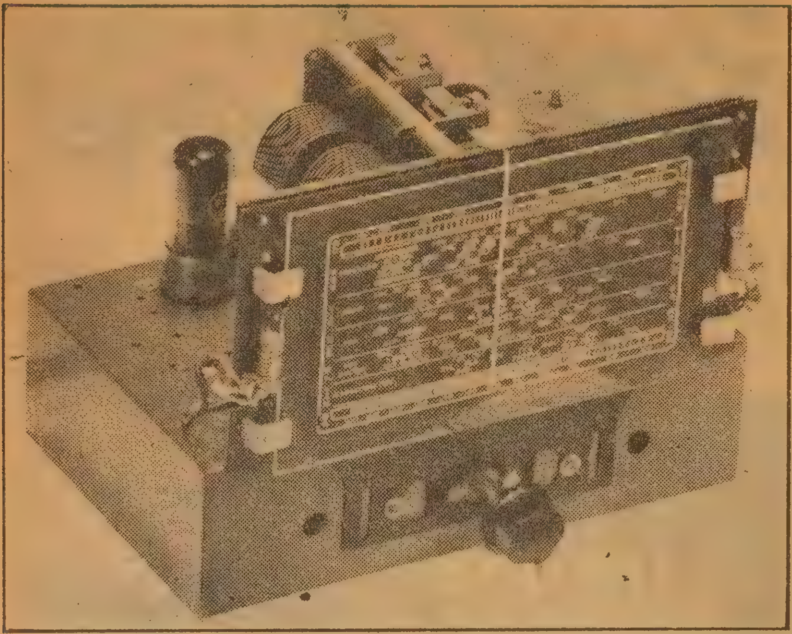
JUST A STEP

It will then be a mere step to space navigation and trips to the moon. But just how valuable the moon might be as an offensive base is open to question. To be sure, its lower gravitational pull might simplify the launching of rocket weapons but, by then, the problem of obtaining adequate propulsion may not be a very serious one. And furthermore, missiles approaching from the moon may be a lot easier to detect than similar missiles hurtling round the circumference of the earth.

If it should appear, however, that the moon is a desirable place from which to launch a war, we can be certain that the atomic arms race will swing, with the utmost urgency, to a moon race. Superman and Speed Gordon will have to move over.

Let us hope, by then, that a little more sanity prevails than seems to be indicated at present on the world scene.

Diamonds are used in dies through which wire is drawn, in cutting wheels. The wire varies from 0.08 inches (the diameter of a knitting needle) down to 0.003 inches. The metal is drawn through a tapered hole drilled in the diamond. The diamond takes so high a polish that the wire comes out smooth as glass.



Only one control—tuning—is required on the tuner although a volume control across the output could be included if desired. In our case, volume for both radio and pick-up is adjusted at the Control Unit which also provided bass and treble boost and cut. But an extra control is handy if there is a big difference between the levels from the pick-up and the radio.

first station by a small movement of the dial, so that it won't interfere as we tune in to the second station. The ordinary set frequently has to do this, and good selectivity is therefore an asset.

The requirements of a wide range tuner are quite different. Firstly, it isn't much good talking about wide-range reception from distant stations, because there will generally be too much fading, static and interference from local stations to make the programs of any use. We must confine our listening to the strong locals.

This means, of course, that selectivity need be only good enough to separate these locals one from the other. If we can do this, extra selectivity isn't of any value.

The relationship between selectivity and wide-range can be visualised simply if we remember that, to receive a programme with a response flat to 10 kc, our tuner must be able to tune 10 kc either side of the station's exact frequency without any loss of signal strength. If we think of this in terms of the normal frequency curve, which plots relative signal strength against the number of kc "off-tune," we would need a curve which has a perfectly flat "top" 20 kc wide, and a "skirt" or sloping sides steep enough to indicate that the strength of the station has fallen to a very small amount before the next one we want to hear

THE PLAYMASTER TRF TUNER

This month's addition to the Playmaster series is a wide-range broadcast tuner designed for high-grade local station reception. It is virtually the tuning end of the Recording Amplifier described some time ago, which has given splendid results over quite a period. It is quite easy to build.

by John Moyle

GIVEN a good speaker and amplifier system, it is well worth while considering a special tuner to match, which will do justice to the frequency range you have taken so much trouble to build into your gear.

The vast difference between the response of good records played with a high-grade pickup and that of the same records received via a broadcast station and conventional superhet. tuner is due to two major factors.

The first is that many broadcast stations do not give an even frequency response over the full range, particularly over 10 kc. The second is that an ordinary superhet. tuner is so selective that it attenuates very sharply those frequencies above about 4.5 kc.

We don't desire at this stage to commence a discussion about the good and bad points of the broadcast stations. They are very much better than allowed to sound through an ordinary superhet. tuner, and if we use something better, we can tell the difference quite easily on good records—particularly microgrooves—and on good studio or concert hall broadcasts.

When we say that the selectivity of a superhet. tuner causes us to lose out on the high frequencies, what we mean is that the tuner's response falls away quite sharply as we tune away from the station. At about 3 kc away on either side the reproduction begins to sound very poor indeed, and by the time we detune, say, 5 kc, we haven't much of the signal left at all.

SHARP TUNING

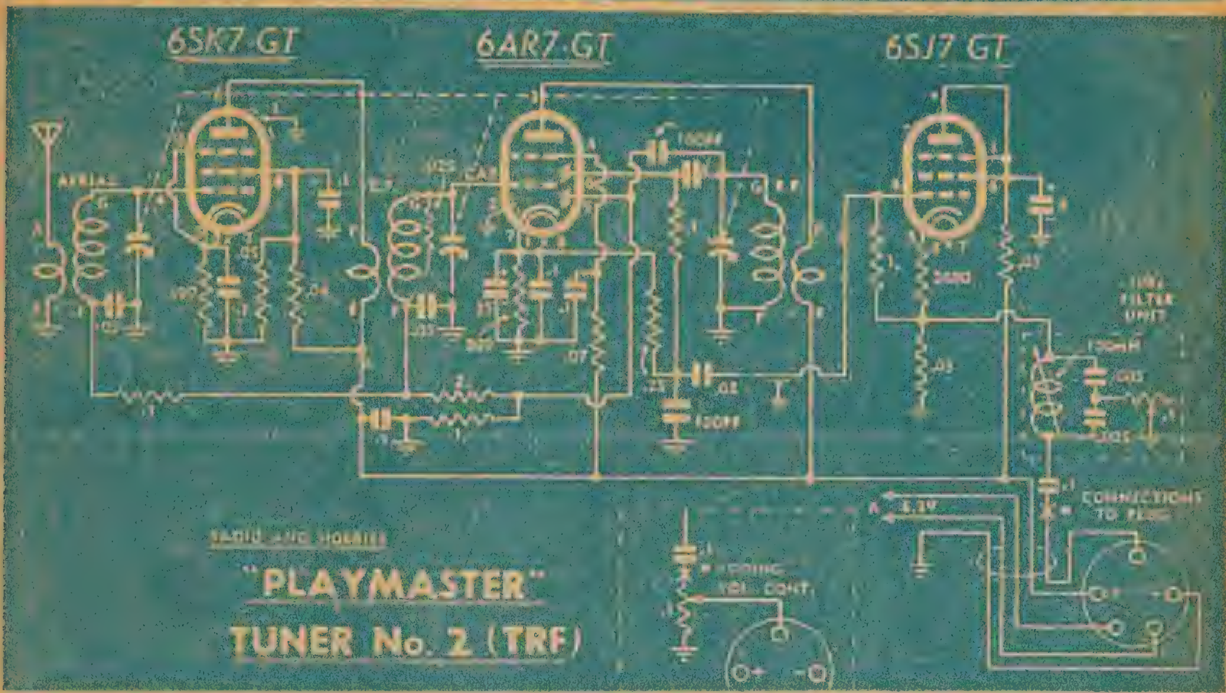
This characteristic is very useful if we want to hear a second station spaced quite close to the first. It's an advantage to be able to "lose" the starts to come in.

The superhet. tuner of normal design has a decided "point" to its curve without any appreciable "flat" at all, and as we have said, shows a substantial drop in signal strength even 2 or 3 kc away from the centre. By the time we reach a point 10 kc either side of the centre, there probably isn't any signal left at all.

By elaborate design of the intermediate transformers, generally using a number of tuned circuits, each resonating at different points near the centre frequency, we can wangle a top which is substantially flat over something like the required amount, still without sacrificing too much of the steep skirt we want for station separation. This is a special type of tuner, not at all suited for adjustment without laboratory instruments. We must, therefore, rule it out in our search for a simple circuit which will improve over the superhet. as we know it. It is doubtful whether you could buy such a set at the present time.

And so we turn to the TRF tuner as an interesting compromise. The selectivity of such a tuner isn't nearly

CIRCUIT DIAGRAM OF TRF PLAYMASTER TUNER No. 2



The circuit of the tuner holds few difficulties even for the near novice. It includes a supplementary circuit showing a suggested volume control which can be added to operate in addition to that already existing in the Control Unit. If the tuner is to be operated any distance from the rest of the equipment, this second volume control would be quite useful.

as sharp as a superhet, but has a curve with very much shallower sides.

By connecting selected values of resistors across the tuned circuits, we can accentuate this shallow chararcteristic and there is no need to stop until we have broadened the curve so much that the local stations can only just be separated. As already explained, there isn't any point in using any better selectivity than this.

If we look at the top of such a curve, we will find that it isn't nearly as sharp as the superhet. It isn't flat either, and we will still get appreciable attenuation at our test figure of 10kc. But the important point is that there will be a useful signal audible over a much greater range than with the superhet and as a result, we will hear a great deal more of the higher frequencies.

STILL NOT PERFECT

We would stress the point that the TRF still has its limitations, and for various technical reasons, coupled with the design of the coils, will give better results at the high frequency end of the dial than at the low frequency end. But bearing in mind the need for a circuit which the average home builder can make up without special test gear, it is, in our opinion, not only the best approach to higher quality, but one which is very much worthwhile.

This is rather a sketchy outline of the principles involved, but it will serve to explain why we chose this type of circuit. In a future issue, we may find space for an article giving a more detailed analysis and comparison of tuners and their bandwidth, and even go on to suggest ways of improving on the results obtainable from the TRF set. It is doubtful, however, whether we can evolve and such method which will compare with this tuner for simplicity and ease of construction.

TWO STAGES

There is nothing at all complicated about a TRF tuner. It is made up of two sections—the RF amplifier and the detector which extracts the audio signal for transmission to the amplifier proper.

General experience has demonstrated that two stages of RF amplification are desireable to provide enough gain, and enough initial selectivity, to provide for all cases. A single stage would probably be adequate in many instances, but our tuner is meant to cater for every case if possible.

The valves used will provide plenty of gain without risk of instability. Modern coils are quite efficient, and the latest types of valves provide so much gain that, in such a circuit, the two together can easily produce oscillation. This is undesirable, not only because an unstable set is always unsatisfactory, but regeneration, even if it will not support oscillation, will sharpen up the tuning, and thus offset our endeavors to produce a more or less flat top to the selectivity curve.

Actually the choice of valves isn't particularly critical, and even the old 6.3v and 2.5v series could be

PARTS LIST

1 Chassis (10" x 6½" x 2¼").
1 Dial to suit gang (USL/32 or similar).
1 Aerial Coil.
2 RF Coils.
1 100mH coil (see diagram).
3 Octal sockets, 1 5-pin plug.

VALVES:

1 6SK7-GT, 1 6AR7-GT, 1 6SJ7-GT.

CAPACITORS:

1 3 section gang (AWA or "H" type)
3 Trimmer capacitors.
3 100 pf mica.
2 .005 mfd. mica.
1 .02 mfd. 200VW.
2 .05 mfd. 200VW.
3 .1 mfd. 200VW.
3 .1 mfd. 400VW.
1 8mfd. 525V electrolytic.
1 25 mfd. 40V electrolytic.

RESISTORS:

2 300 ohm ½W.
1 2000 ohm 1W.
1 .025 meg. ½W.
1 .04 meg. 1W.
2 .05 meg. ½W.
1 .05 meg. 1W.
1 .07 meg. ½W.
2 .1 meg. 1W.
1 .1 meg. potentiometer.
1 .25 meg. ½W.
2 1 meg. ½W.
1 2 meg. ½W.

SUNDRIES:

Knob, terminals, tag strips, hook-up wire, shielded hook-up wire, solder lugs, nuts and bolts.

employed without circuit alteration.

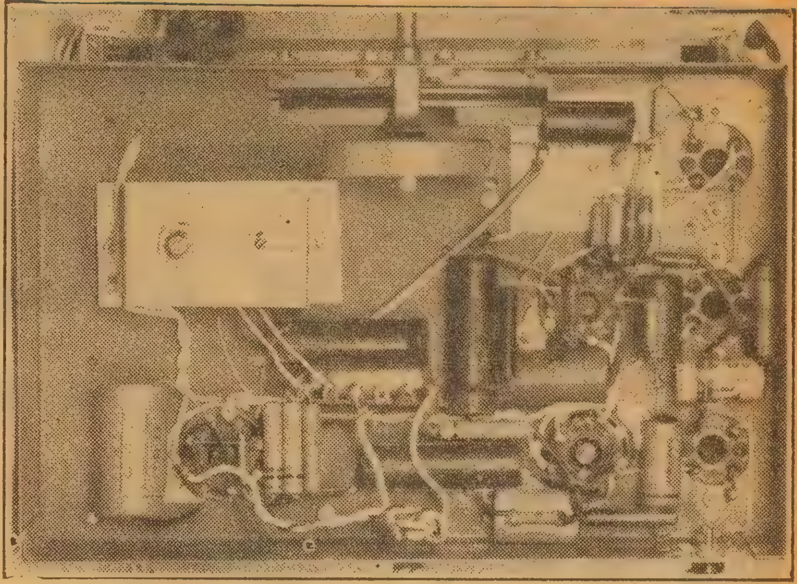
Standard diode detection is used, and an AVC circuit controls both IF amplifiers to keep the output from various stations more or less even over the tuning range.

The AVC allows us to do away with a volume control on the tuner itself, as the audio control in the amplifier is quite able to make up for differences in signal strength. These are likely to be more noticeable than they would be in many superhet circuits because of the lower overall RF gain. As it is usual to reset the volume in any case when changing to one station from another, this isn't a point regarded very seriously.

The only other point of design worth special mention is the cathode follower output and whistle filter. Both these will be familiar to close students of our circuits. Both were used for the first time in the "Junior Recorder," but have appeared in several circuits since then.

With a comparatively inselective receiver such as this, we are liable to hear a high-pitched whistle at a frequency of 10kc when tuned to some local stations.

UNDER CHASSIS VIEW OF TUNER



This underchassis photo of the unit will be helpful when wiring up. The white oblong is the filter unit.

INTERFERENCE

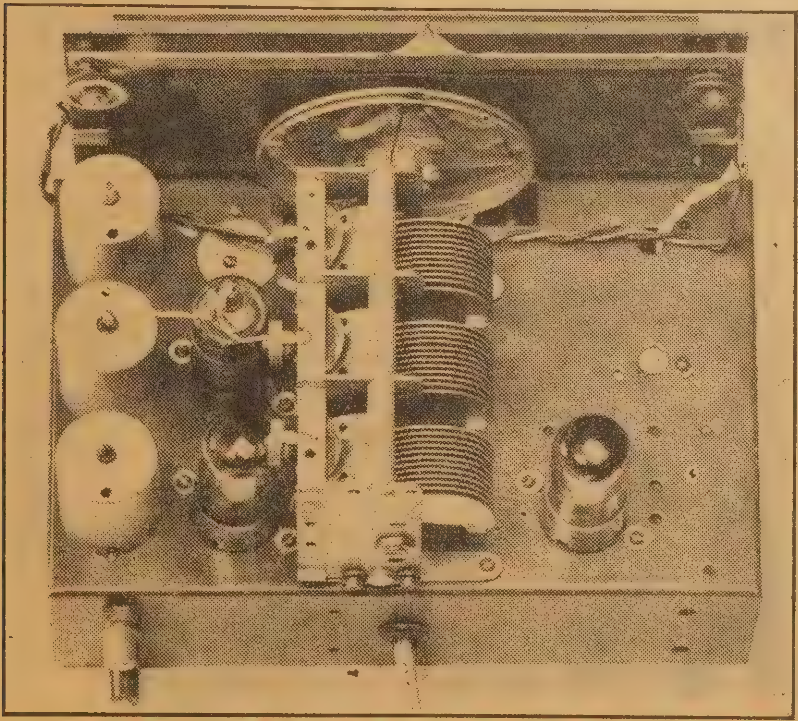
This whistle is caused by interaction between the carrier of the station to which we are listening, and another station occupying an adjacent channel on the broadcast band. Even though the unwanted station may be some distance away, sometimes it is received strongly enough for the whistle to be heard.

The fact that this 10 kc whistle isn't audible on the ordinary superhet. receiver indicates the truth of our earlier explanation that such a set is sadly deficient in high frequency response. But with our TRF tuner, particularly if the loud speaker is of high quality, some of these heterodyne whistles can be unbearably strong.

The remedy is to include in the circuit a filter unit which will trap out a section of the audio spectrum at 10 kc, but will not affect frequencies more than a few hundred cycles away. The filter we use is so sharp that it effectively cuts a slice of the spectrum right out, the slice being so narrow that it isn't missed on music.

It is almost impossible to design a satisfactory filter which can be connected directly into the diode circuit, as its impedance is too high. It is necessary to feed the filter from a low impedance.

Such a circuit is quite easily provided by connecting a triode valve as a cathode follower. This circuit has a very low output impedance on the one hand, and a high input impedance on the other, which is a very good thing to have following a diode detector.



Layout above the chassis is clearly set out here. The cathode follower valve is the one at lower right. The 6SK7G is the valve in line with it to the left.

CHOICE OF VALVES

Almost any triode valve at all will do as a cathode follower, or almost any pentode connected as a triode. There is no gain obtainable from this stage, and differences between valves will merely alter the exact value of the output impedance, which is approximately equal to 1/Gm. A 6SJ7 wired as a triode is a convenient valve, and a 6J5 type would do equally well.

The filter is made up of a coil of wire wound on an RCS type choke bobbin, and tuned with an iron slug similar to those used for coils and IF transformers. A potentiometer and a couple of mica condensers make up the remainder. They are mounted on a simple little metal bracket you can easily bend up, so that the iron core can be screwed in and out of the coil.

The unit is adjusted either by feeding a 10 kc note through it from a generator, or by tuning to one of these bad heterodyne whistles on the air.

The unit is resonated to 10 kc by adjusting the iron core, and the amount of attenuation is determined by the setting of the potentiometer. This is set to a value of about 30,000 ohms for a start, and the core adjusted until a drop in the intensity of the whistle is noticed. The set may be tuned a little to one side of the station if it makes the whistle initially louder.

Having found the setting of the core which gives the least whistle, the potentiometer is adjusted until

the greatest possible attenuation results. In most cases this will be so great that at ordinary listening levels the whistle has virtually disappeared.

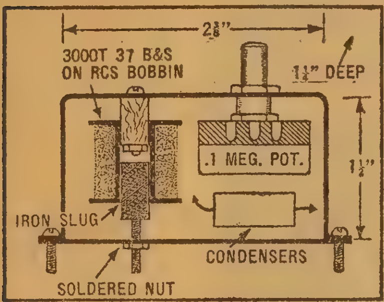
It is important to adhere to the gauge of wire and number of turns given, otherwise the coil may not tune to 10 kc.

These general instructions have been given in previous issues—in fact, they were covered last month. They are repeated here, however, in order to keep the story complete.

The chassis, on this occasion, was a standard pressed-steel job which we bought ready-punched from one of the local wholesalers. It was originally designed for a range of TRF tuners in the April, 1948 issue and, using the same full-sized components, there seemed little point in changing it. It is just wide enough to accommodate the dial and deep enough to take the tuning condenser. Actual dimensions appear in the parts list.

CIRCUIT LOADED

One of the tuned circuits is loaded with a resistor to broaden the tuning, and as a rule this will be sufficient. A similar resistor value can be wired across the first tuning coil as well if it does not reduce selectivity too far. The third coil is already damped fairly solidly by the diode detector circuit. Adding resistors will reduce sensitivity, but there should be plenty of this.



The filter unit is made up to conform with the above diagram.

The tuner is designed to connect to either of the Playmaster Control Units via a five-pin plug which carries the audio output as well as the power connections. It can be used with other amplifiers, in which case the output connections may have to be modified to suit. The tuner must not be earthed to, or otherwise connected to either the control unit or the amplifier to avoid hum being introduced by earth loops.

Lining up the tuner consists merely of setting the dial to one of the local stations and lining up the trimmers, which are mounted across each gang section, until the station is heard at best strength. If the dial has been selected for use with your particular type of gang condenser—and this is important—and if you have initially set the dial to its high frequency limit with the gang plates fully unmeshed, the other stations should fall into their places.

Used with any of the Playmaster amplifiers and Control Units, this tuner will give exceptionally fine radio reception, of a stadard unlikely to be surpassed by any other type of radio receiver available at the present time.

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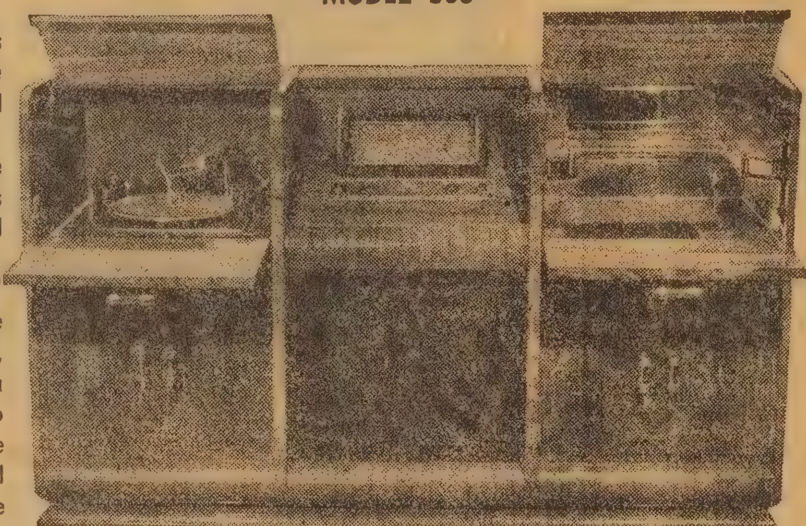

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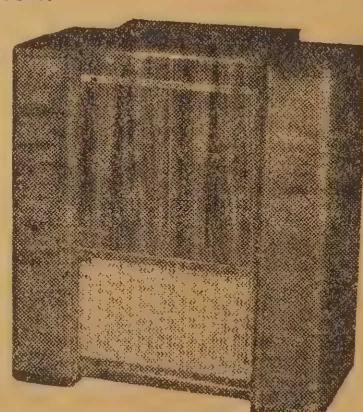

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A COURSE IN TELEVISION

PART 34—TELEVISION AERIAL SYSTEMS (cont.)

Continuing the discussion of VHF television aerial systems, we discuss this month the subjects of aerial impedance, aerial matching and the means of connection to a receiver. Reference is also made to directivity and to simple beam arrays.

THE term "aerial impedance" will be foreign to those who have thus far had dealings only with ordinary variety of aerials. While it will be appreciated that such aerials must have a certain amount of inductance, capacitance and resistance, the ultimate figure of impedance which these properties might produce at a given frequency is as random as the aerial's length and height.

The moment, however, that an aerial is made resonant at the signal frequency, its characteristic impedance can be stated and, indeed, must be taken into account if proper connection is ultimately to be made to the receiver.

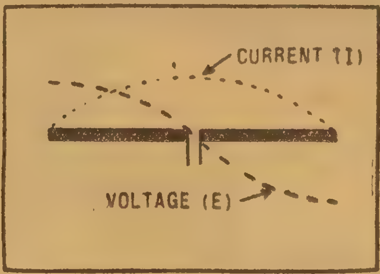

Figure 1. The distribution of current and voltage along a resonant dipole. Apparent impedance is minimum at the centre, where I is high and E is low.

AERIAL IMPEDANCE

The subject of characteristic impedance can become extremely complex with multi-element arrays but it presents no special difficulties in the simple dipole.

As mentioned in the last article, a resonant dipole can be regarded fundamentally as a tuned circuit, involving L, C and R and capable of ready oscillation when excited at its resonant frequency. One can speak quite legitimately of its "selectivity" and "Q" factor.

When excited by a signal at its resonant frequency, a dipole exhibits a distribution of voltage and current along its length, which is normally depicted as in figure 1.

It will be seen that the intensity of the alternating signal current flow is greatest at the centre, dropping to near zero at the ends. Conversely, the peak signal voltage with respect to earth reaches a maximum value at the ends but drops virtually to zero in the centre.

At all points along a dipole, therefore, there is a specific relationship between the instantaneous voltage and the instantaneous current and this can be expressed as the characteristic impedance of the aerial at that point. It is necessary only to recall Ohm's law, which states that R equals E/I.

At the ends of a dipole "E" is high and "I" is low, so that "R" must obviously be high. Conversely, at the centre of a dipole "E" is low and "I" is high, so that the centre is the point of lowest resistance (or impedance, to be somewhat more precise).

TYPICAL FIGURES

Fortunately, these observations can be resolved into quite simple figures which apply to all dipole aerials. The following general statements can be made:

(1) The impedance at the centre of a simple dipole, operating at its resonant frequency, approximates 73 ohms.

(2) The impedance at the ends of a simple dipole, operating at its resonant frequency, approximate 3000 ohms.

(3) The impedance at points intermediate between the centre and the ends will lie between the figures suggested in (1) and (2).

Actually, the precise values vary somewhat with such factors as the height of the aerial above ground, but the figures quoted are usually acepted as a basis for calculation and design.

It is important to remember that they apply only for the frequency at which the dipole is naturally resonant or at least within the range of adjacent frequencies to which the aerial may be regarded as being responsive.

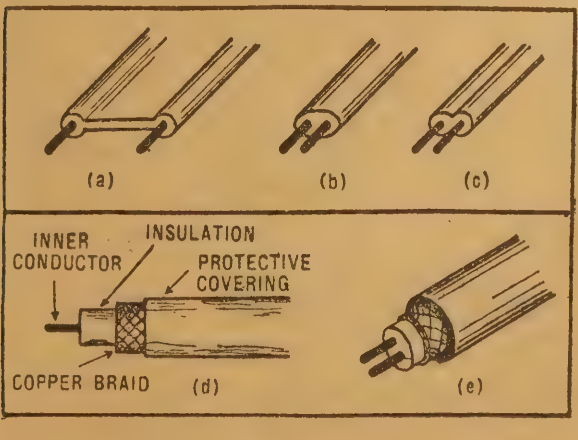

Figure 2. Sketches (a), (b) and (c) illustrate typical plastic - insulated twin line. (d) shows the details of a coaxial cable, while (e) illustrates the less common shielded twin line.

TRANSMISSION LINE

The lead wire connecting the aerial to the receiver must be suitably chosen if proper signal transfer is to be affected. It rejoices in the name "transmission line" or "feed line" and usually involves two separate conductors arranged either to be parallel or concentric.

In most cases, the transmission line is connected to the centre point of the aerial, one conductor to each of the elements.

The aerial provides the load or termination for the transmission line and, ideally, the aerial impedance at the point of feed should constitute the appropriate termination for the type of transmission line which is selected.

In the simplest case, where the aerial is resonant dipole, the centre impedance is about 73 ohms and this figure has to be taken into account when attaching the transmission line. More complex arrays exhibit differing impedance figures which can usually be ascertained from aerial design data.

Folding a dipole, for example, multiplies the normal dipole input impedance by a factor of four times which thus steps it up to 4 x 73 equals 292 ohms.

FOLDED DIPOLE

By making up a folded dipole having three or more parallel rods or by using rods having different diameters, a wide range of effective input impedance figures can be achieved.

The principle of multiplying impedance figures with a folded dipole is commonly employed in association with beam arrays. As a rule a dipole which is part and parcel of a beam array exhibits a much lower impedance than the usual 73 ohms and it may fall to such a value that it cannot be coupled conveniently to a transmission line.

In such a case, folding the dipole

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may multiply its impedance at the point of feed to a more practical figure.

The designer of a complete VHF aerial system thus starts off with a knowledge of the transmission lines available and the general type of aerial he wants to use. It is then a matter of compromise and adjustment to derive an acceptable aerial which will exhibit an input impedance to match the required terminating impedance of a suitable line.

Now for a brief discussion of transmission lines.

For receiving purposes, the usual plan is to employ an electrically "flat line." This is achieved by making sure that the characteristic or surge impedance of the line is the same as at the feed point on the aerial and also at the coupling coil of the receiver or transmitter.

When this condition is achieved the transmission line can be of any convenient length and there should no noticeable variation in results if the line is made longer or shorter for reasons of convenience.

The characteristic impedance of a transmission line is determined by the diameter of the conductors, the spacing between them and the nature of the intervening material —be it air or solid insulation.

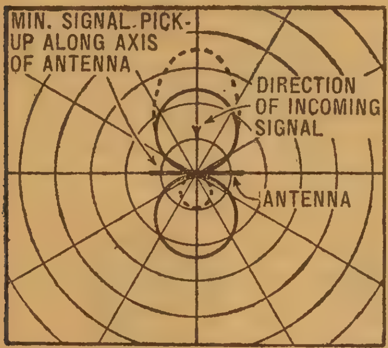


Figure 4. This plan drawing illustrates (solid curve) the directive qualities of a simple dipole. Addition of a reflector and possibly a director gives the uni-directional response as shown dotted.

The exact figure can be calculated by appropriate formulas but the average enthusiast is usually satisfied to accept published figures for lines of different type.

The most elementary transmission line consists simply of two wires run side by side and spaced evenly with suitable insulating blocks. This is referred to in textbooks as an "open wire" transmission line and tables have been published showing characteristic impedance of lines made up using certain gauge conductors and spacing.

Actually, the characteristic or surge impedance is determined by the relationship of inductance and capacitance per unit length and this is a function of wire diameter and spacing.

Another type of transmission line, which is popular at the moment, consists of two parallel wires moulded into a continuous ribbon of low loss plastic. Typical impedance values available are 75, 150 and 300 ohms.

Again, the popular plastic flex used so widely for 240 volts AC leads, makes quite a useful transmission line provided matters are arranged to utilise its characteristic impedance of 150-odd ohms.

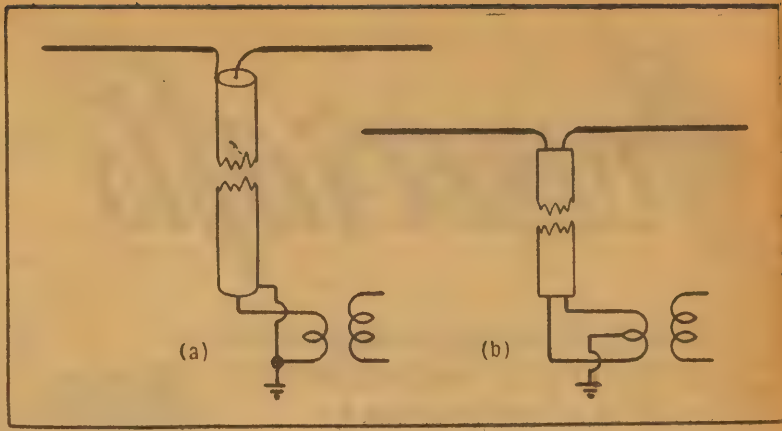


Figure 3. Coaxial cable (a) can be joined to the aerial primary as shown, neglecting unbalance for receiving purposes. A balanced line and connection is shown at (b).

The older rubber and cotton covered twisted flex has a characteristic impedance of about 70 ohms but is much less efficient electrically than wires encased in plastic.

All these transmission lines are inherently balanced by reason of the fact that both conductors have approximately the same capacitance to the aerial, to earth and to surrounding objects.

The best example of an unbalanced transmission line is the now well-known coaxial cable. This, in its most popular form, consists of an inner conductor surrounded by low loss plastic with an outer conductor of copper braid. Over this again there is usually an outer plastic layer for protection against abrasion and weather.

COAX. CABLE

The characteristic impedance of a coaxial line is dependent on the diameter of the inner conductor, the distance to the outer conductor and the characteristics of the insulating layer. Most common values are 55 and 75 ohms.

The older varieties of coaxial cable had beads spaced at intervals rather than solid insulation, between the conductors and, occasionally, a solid rather than a braided outer conductor.

Cable has also been manufactured with two parallel conductors inside an outer brading, thereby combining the characteristics of balanced and coaxial lines.

Broadly speaking, any of thes transmission lines can be used a the link between the aerial and re ceiver, the most important poir being to see that some degree c matching is achieved between aeria and transmission line.

Another feature worth mention i passing, is the RF loss in a trans mission line, due simply to high fre quency resistance of the conductor and loss in the insulation. It is ex pressed in terms of decibels per 100 but, for most purposes, the losses ar not likely to be noticed in an ordi nary domestic installation.

The installation of a transmissio line is relatively simple, althoug one or two mechanical points nee to be watched.

In the first place, the connectio between individual leads and th aerial elements should preferably b clamped as well as soldered so tha the joint will not suffer either b reason of vibration or by deterior ation.

It is wise also to clamp the lin to the supporting pole every foot o so, particularly if it is of the fla ribbon type. The ribbon tends t stretch and slacken with time an long unsupported lengths, flappin in a wind, will ultimately fracture

As far as possible, the line shoul drop away directly from the aeria for at least a ½ wave length an it is wise to avoid sharp bends o passing the ribbon tightly aroun metal objects.

Figure 5. The general dimensions of a 3-element beam, as commonly employed in low signal strength areas. Using a folded dipole, input impedance at centre is about 120 ohms. It is nearer 30 ohms with a single dipole as the centre element.

Mounting the aerial horizontally automatically brings into account its directive qualities and the polar diagram for a dipole resembles a figure 8 as shown. In other words, signals are heard to best advantage broadside to the aerial and poorly from the directions in which the elements are pointing.

Actually little difference would be apparent in the strength of signals up to 45 degrees off the broadside position but nearer than this to the axis of the elements would drop the signal strength considerably.

It is wise, therefore, to mount the aerial so that it is approximately broadside to the direction of the incoming signal. When signals arrive from all points of the compass, the only possible course is to orientate the aerial so that its least sensitive zone coincides with the strongest signal.

DODGING NOISE

In some cases interfering noise can be identified and use can be made of the directive qualities of the aerial by lining up its axis with the noise zone while still allowing good pickup from the required stations. Obviously each installation has to be treated on its merits.

In noisy locations, or near the outskirts of a city, there may be an advantage in providing an aerial system which is sensitive in one general direction only. In other words, there is often a good case for installing a "beam aerial" and, if additional gain can be achieved in the desired direction, so much the better.

A simple beam aerial can be arranged by erecting a horizontal dipole broadside to the desired signal then mounting behind it a "reflector" element.

For receiving purposes, the reflector is normally mounted one quarter wave behind the dipole and made approximately 5 pc longer than it. In other words it will approximate in length an electrical half wave. The diameter of the reflector is not important although, for the sake of convenience it is usually cut from small diameter tubing and clamped at its centre to the supporting boom.

MAKING UP A BEAM

The effect of adding a reflector behind a dipole is illustrated by the broken line on the polar diagram. It is noteworthy that the pick-up or gain of the aerial is increased substantially in the forward direction while there is very little pick-up from the sides or the rear of the beam.

The beam effect may be increased still further, by adding a "director" element in front of the dipole. This is normally made about 4 pc shorter than the dipole but in other respects the same remarks apply as for the reflector.

The use of a three-element beam gives an increase in the incoming signal level of about five decibels while it discriminates against possible interference arriving from all but the forward direction.

To achieve additional "forward gain," it is possible to use a couple of directors or to "stack" beam arrays one above the other. Typical aerial arrays will be dealth with in the next article.

Here's your answer, Tom!

The first of our several "Toms" for this month admits that he doesn't know a darned thing about electricty. Being tired, however, of having the lights go out just as he's about to tuck into a nice juicy steak, Tom set about to produce an emergency lightnig system.

HAVING procured a 6-volt battery with some globes to match, ıe proceeded to wire up the lights according to a circuit in the Sunday paper. The battery was duly installed in the toolshed, where acid would not be spilled on the furniture, and lengths of power flex run to lights placed at strategic points n the kitchen and living-room.

However, bitter disappointment followed Tom's first flush of pride when, on throwing the first switch, the lamps greeted him with a sickly yellow glow instead of the expected white radiance. The lamps work-

ed according to plan when connected direct to the battery in the initial tests, so naturally, Tom blames the connecting wires. This is where ıe brings forward his poser.

If the power flex is good enough for 240 volts, why is it not good enough for six volts?

Tom, my boy (metaphorically speaking, of course!) little do you realise how fundamental is the question you have asked. We could easily devote the whole section this month to the answer, but we will see if we can be a little more concise.

WHAT IS A VOLT?

Looking at the question a second time, the difficulty seems to centre around the word "volt." What is its importance? What difference does it make if we have six of these volts or 240 of them? When we answer our own questions we will automatically answer yours, too.

To the uninitiated, electricity is a very mysterious thing, indeed. If you see an express train hurtling down the track toward you there is no doubt about what action you should take to keep yourself in one piece. The train and the track are things you can see, feel and hear. But not so electricity! The most innocent-looking pair of electric wires can contain a thunderbolt which will be released in all its fury against the first person who dares to touch them.

Because electricity does not make itself evident to our senses directly, it is helpful to think of it in terms of something that does. Take water, for instance. Water can be made to flow in a pipe in something after the style that electricity flows in a wire. It can be stored in a tank as electricity (or equivalent energy) can be stored in a battery.

Say, for instance, that we have two tanks, one at the top of a hill and full of water and the other at the bottom of the hill empty, with a connecting pipe between the two. Commonsense tells you, of course, that water will flow from the higher tank down to the lower.

The greater the height of the upper tank the faster the water will flow between the two, because the pressure will be greater. Alternatively, you can make the water flow faster by using a larger diameter pipe because the resistance to its flow offered by the larger pipe is less.

WATER ANALOGY

When we come to think about electricity we can consider the voltage like pressure in a system of water and pipes. Electrical resistance has the same effect on the flow of current as physical resistance (or small diameter pipe) has on the flow of water. So you see that with electricity you can increase the current either by increasing the voltage or decreasing the resistance.

Coming back to your lighting system, Tom, the wire you used to connect the battery to the globes has a certain fixed amount of resistance. When connected into a 240-volt system, the pressure of the electricity is so high that the resistance offered by the wire does not have any worthwhile effect on the amount of electricity flowing.

The only worthwhile amount of resistance is offered by the globe itself, and the work that the electricity does in overcoming this resistance is used up in creating the light you require.

However, when you use the same wire with the 6-volt system, the resistance offered by the wire is no longer negligible, since there is only 1/40th the pressure. Some of the energy of the electricity is wasted in the wire, with the result that the lamp has to go short. Hence the yellow lights.

The solution to the problem, Tom, is to reduce the resistance of the connecting wires. You can do this either by making them shorter or by using thicker wires. With a 6-volt system, it is very difficult to make the resistance low enough and you have to use thick wires and keep them short if the lamps are to work efficiently.

EFFECT OF PRESSURE

There is one advantage in using the low voltage, however. Going back to the story of the pipes and the water, you will realise that if you have high pressure in the pipes they will need to be strong to withstand it safely. With electricity the insulation around the conductor has to be good if the pressure, or voltage, is high. With the 6-volt system you need not take such elaborate precautions against the possibility of the current shorting or giving someone a shock. As a matter of fact, you can quite safely touch the terminals of a 6-volt battery without getting a shock.

Just to round off the story, Tom, we would like to point out that it is possible to operate lights that are just as powerful as the 240-volt lights from the 6-volt battery. With the 6-volt battery the current has to be much greater for the power to be the same.

The allegory about the water is all very well when you are learning about electricity and, above all, wish to get

some sort of mental picture of what goes on in an electrical circuit. The danger is that you will try to push it too far and in so doing make the matter even less clear than before.

For example, if you attempted to push the idea to cover valve theory you would picture thermionic valves squirting streams of water or something equally ludicrous. As soon as it has served its purpose, forget about it and learn to think directly in electrical terms.

I have a set which gives me a tingling sensation whenever I touch the chassis. Does this indicate a fault? The set has an earth wire to a water pipe and I notice a slight spark when the earth wire is connected to its terminal.

That's a touchy question, Tom, because it involves a factor of safety and we don't want to mislead anyone.

Quite a few sets we have seen exhibit the effects you speak of but are not really faulty. Possibly due to the design of the power transformer, there is some reactive coupling from the mains to the circuits of the receiver. Though small, it is apparently sufficient to produce a small current to flow through the chassis to earth.

TESTED OKAY

We have frequently checked sets showing this effect and failed to discern any appreciable DC leakage between the primary circuit and earth. They would produce a tingling sensation when touched under certain circumstances, but there was no suggestion of a dangerous shock.

Some sets and quite a few test instruments have condensers deliberately wired between each side of the mains and the chassis for filtering purposes, and these can produce a mild though not dangerous shock for anyone who gets between the chassis and earth.

All this pe-supposes, Tom, that only a 2-wire power lead is connected to the set or instrument in question. By far the safest and the proper way is to use 3-core power flex to the device, make sure that the earth wire is connected to the chassis and that the outfit is plugged into a properly wired 3-pin power point. That way, you simply can't get a tingling or a shock either.

It offers protection, also in the event of a breakdown occurring between the transformer primary and some portion of the receiver circuit.

> A Melbourne reader writes to say that he is now obliged to give up his radio activities. He will be happy to present some useful radio parts, now surplus, to any young chap who is starting out in the hobby.—C. Goodison, 23 Saunders Street, Coburg, Melbourne.

Such a circumstance can be really dangerous and the 3-way power connection is the only complete protection for all concerned. It will either render the power leak harmless or simply cause the fuse to blow.

Blown fuses are a nuisance, but they're a lot easier to replace than blown Toms!

I have recently attached a microphone gadget to the pickup terminals of my radio set but all I can get is a lot of howling when I turn up the volume. The set works all right with a pickup.

We take it from what you say that the microphone you have is a carbon type, complete with battery and transformer. It is doubtful whether any other type of microphone would have enough output to work directly into pickup terminals.

It is just possible also, Tom, that you haven't been sufficiently careful with earthing arrangements and that some of your troubles could be overcome by a little attention in th direction.

It is much more likely, howev that your troubles are due to dire interference between the micropho and speaker.

As a general rule, it is not possib to use a microphone and a lou speaker in the same small room, e cept under conditions where the ga between them is very low indeed

What really happens is this: Y turn up the gain and some sma random sound reaches the micr phone. It turns out a correspondi signal, which is amplified and f through to the speaker.

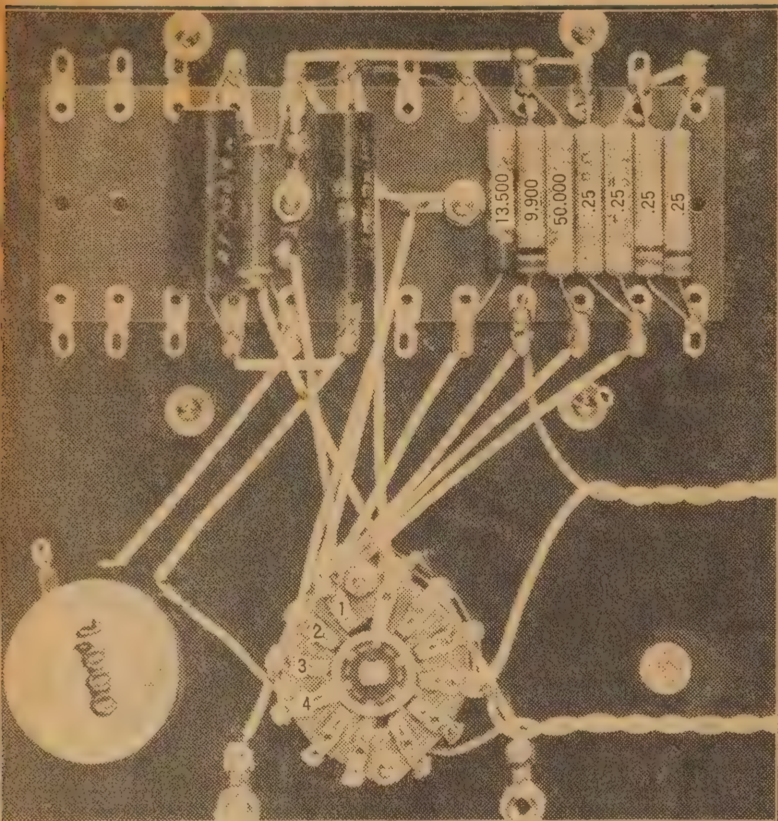
The resulting sound from t speaker reaches the microphone a creates a stronger signal for the an plifier. This produces a louder noi from the speaker, which induces still stronger signal from the micr phone and amplifier and a louder si nal than ever from the speaker! So goes on till the whole system osci lates violently with a loud howlin noise.

WHAT TO DO

The only way to stop it is to tur down the gain or to put the micr phone where the sound waves fro the speaker can't reach it.

In other words, if you run tl microphone out into another roo and shut the intervening door, tl chances are that you'll be able use it to some better effect.

People who instal big public ad dress systems are constantly bother with this "acoustic feedback Tom, and use special direction speaker flares and selected micr phones to deal with the more difficu cases. You're by no means on you own.



Rear view of the meter showing the extra resistors on the right hand side of the terminal panel. Note also the link between the four switch contacts on the top left of the switch.

had some acquaintance with Ohm's law we will briefly review the mathematical approach to this problem, hoping that others may also find it sufficiently interesting to follow. However, if you feel that this is out of your line, or if the going gets too tough, you can pick up the threads a little further on without fear that your ability to build the instrument will be in any way impaired.

OHMS LAW

Ohm's law may be presented in the form of three formulae, each providing the solution of one of the factors when the other two are known. The three factors are voltage, current and resistance, the last one being the one which usually has to be solved for multimeter calculations, although the others are needed on occasions. The present problem is actually to find voltage from the other two factors.

The formula in this case states that the voltage may be found by multiplying the resistance in ohms by the current in amps. Note particularly that the units to be employed in the formula have been specified and must be strictly

LEARN WHILE YOU BUILD

Probably the two most widely used sections of a multimeter are the ohmmeter and the DC voltmeter. We described the ohmmeter last month and we turn our attention this month to the DC voltmeter. As well as the actual construction there are quite a few points to be considered about the components required and how the finished instrument should be used.

N order to get a clear picture of the operation of a voltmeter it is ecessary to return to the basic O-1 nA meter movement and build our oltmeter circuit around it.

As we said before, this meter is undamentally a current measuring evice. That is to say, it will indiate the passage of current through he moving coil by a deflection of he pointer, full scale reading being ndicated when the flow is one milliimp.

OLTAGE

But current will not flow through he coil unless there is something to roduce it and, as you have probbly guessed, that "something" is oltage. More important is the fact hat the value of current will bear definite relation to both the reistance of the coil and the amount f applied voltage. If we know the rst two factors, we can calculate ow much voltage is applied to the oil.

In this case we do know the resistnce of the coil—100 ohms—while the amount of current may be read from the scale, so that any reading may be converted from an indication of current through the coil, to one of voltage applied to it.

Better still, the tiresome calculations can be avoided by having the scale calibrated for volts rather than milliamps. Thus, whether the meter is indicating voltage or current is really a matter of how the scale is calibrated, for both must be present and it is merely a matter of selecting the one required.

And just how much voltage is required to force one millamp through a meter resistance of 100 ohms?

For the benefit of those who have

by Philip Watson

adhered to, a point which is frequently overlooked by beginners.

Thus the resistance of the meter —100 ohms—should be multiplied by the current flow which, being converted to amps, is .001. .001 multiplied by 100 equals .1 volt, the value required to force 1 milliamp (.001 amp) through the meter. (Figure 1a.)

Now, .1 volt (or 100 millivolts) is too low to be of much practical use in radio work, it being very seldom that such values are encountered, but it is important to keep it in mind, as it will aid your understanding of shunt calculations later on. At the moment, however, we are concerned with the reduction of this sensitivity in order that higher voltages more in keeping with values found in radio sets, will be required to force 1 milliamp through the meter.

We do this by increasing the total value of resistance to which the voltage is applied, simply by adding a resistance in series with the meter as shown in figure 1b. The exact

value of total resistance will depend on the voltage range required, and to find it we must revert briefly to our mathematical approach.

In this case the resistance is the unknown factor, while the two known ones are the current through the meter — 1 milliamp. — and the voltage to be applied to the circuit which, let us assume, will be 10 volts. The appropriate formula states that resistance may be found by dividing the voltage by the current (in amps). Substituting figures we have: 10 (volts) divided by .001 (amps) equals 10,000 ohms, the total resistance required in the circuit.

Since the meter already has a resistance of 100 ohms we must deduct this from the 10,000 ohms, leaving 9900 ohms to be provided by the external resistor or multiplier.

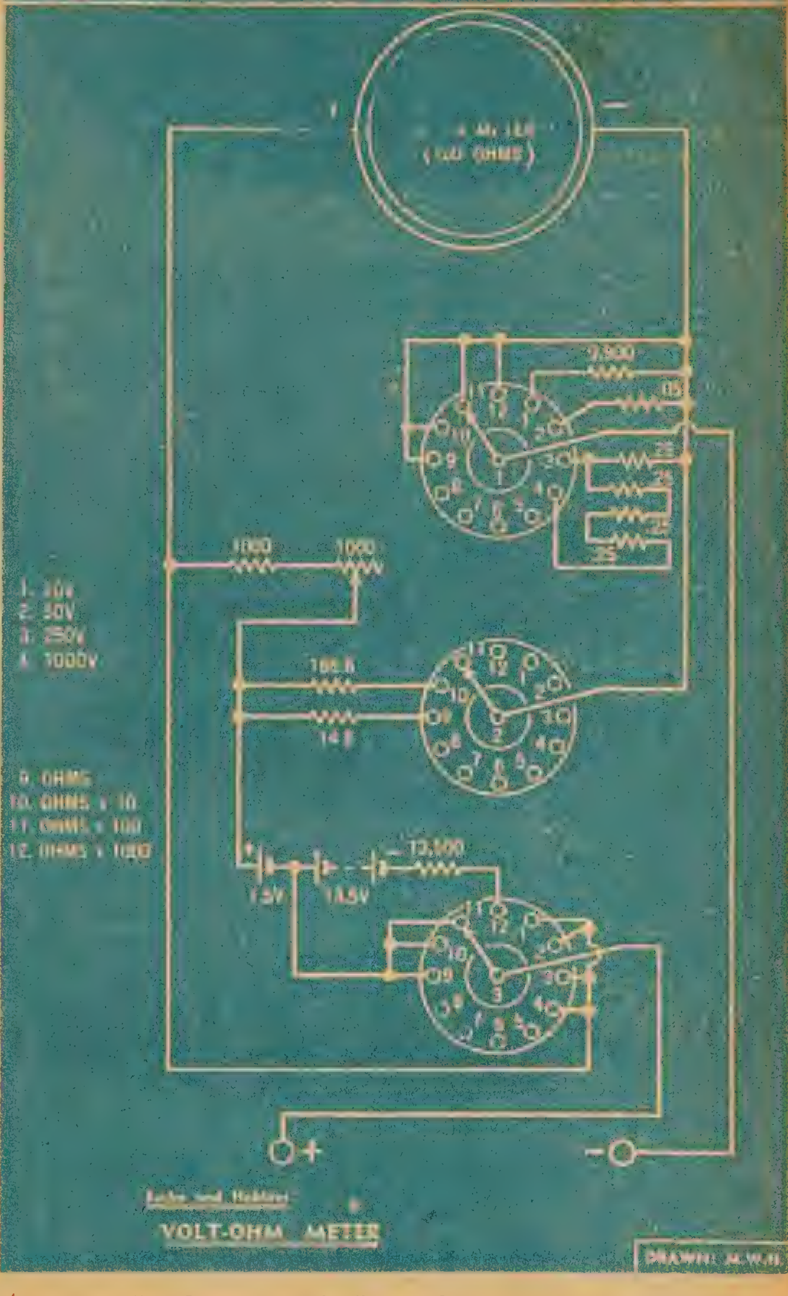
TOLERANCES

This allowance for the meter resistance becomes increasingly important on lower voltage ranges (which are, however, not very frequently featured in standard multimeters) but is of negligible importance with higher ranges, since the percentage error involved is much less than the order of accuracy normally required.

Which brings us to the whole question of tolerances, and the values normally to be expected in a multimeter. Radio components such as resistors and condensers (except where the latter are part of a tuned circuit) are generally regarded as correct in value if within 10 pc, plus or minus. In fact, a figure of 20 pc is often regarded as satisfactory for condensers and also appears to be gaining favor, at least overseas, as a resistor tolerance for everyday application.

For this reason, the voltages and currents found in a receiver are likely to vary by a like amount from the nominal values quoted by, say,

ADDING THE VOLTAGE RANGES



The circuit diagram shows how the additional ranges are added, and it may help to compare this with the one published last month. The wiring diagram shows how the resistors are mounted.

the manufacturer. Thus, an instrument having laboratory accuracy (.1 pc or the like) is quite unnecessary and, indeed, the additional expense would be completely wasted.

What appears to be a satisfactory compromise is an overall accuracy of 2 pc, and this has now been generally accepted throughout the radio trade as being perfectly satisfactory for all forms of servicing meters. Since we have both the meter and the multiplier to consider, the makers of each endeavour to keep within a 1 pc tolerance, making the total possible error 2 pc if both components should have maximum error in the same direction.

The type of resistor used as a multiplier will also depend on the degree of accuracy required and, to achieve the 2 pc quoted, the ordinary carbon resistor as used for receivers is quite unsuitable. Assuming a tolerance of 10 pc, the value of a nominal 50,000 ohm resistor could be anything between 45,000 and 55,000 ohms and the resultant meter sensitivity would vary by a like amount, requiring anything from 45 volts to 55 volts for full scale deflection.

Of course, the resistor could be exactly 50,000 ohms but the point is that we have no means of knowing this, and it must, therefore, be regarded as having this possible error.

If the resistor were one of the 20 pc variety, the error would be just that much worse, the voltage required for full scale reading being anything between 40 and 60. Since only a very few resistors are required to have tolerances better than 10 pc there is no justification in manufacturers striving for this figure, and thus the only source of supply is the stock normally intended for use in receivers.

Fortunately, a few of these will turn out to be within the 1 pc limits and the manufacturers usually pick these out when bulk stocks are being checked immediately after manufacture, paying particular attention to those values which are normally required with close tolerances.

Actually the carbon resistor, even when so selected, is not the ideal type, since its value is not absolutely stable. However, the drift is not sufficient to seriously upset the accuracy. On the other hand they

CLEARANCE BARGAINS

METERS

0-100 MA American "Triplet" Meters, 2" Square model. Brand new, ex disposals. Worth at least 60/-.

32/6

0-1 MA English make, 2¼" Square model, with luminous pointer. Brand new, ex disposals.

32/6

0-600 volts Ferranti meter, 3" Square model, with separate multiplyer. Brand new, ex disposals.

50/-

Postage and packing 2/- extra.

MARCHING COMPASS

Magnetic type in bakelite case, with adjustable reflector and luminous markings. Size 2¼" x 2¼". Ideal for hikers, etc. Brand New.

29/6

Postage and packing: NSW 1/6; Interstate 2/6.

PICK-UPS

COLUMBIA MAGNETIC PICK-UP MODEL "26"—This is a standard type magnetic suitable for all general purposes, of medium weight with an average output of 1.5 volts. This is a genuine bargain, at less than half price.

50 have been reserved for mail orders, so don't delay.

35/-

Postage: NSW 1/10; Interstate 3/-.

SCARCE LINES AVAILABLE EX-STOCK

ROLA "K8" SPEAKERS ..	£3/1/10
ROLA "K12" SPEAKERS	£3/18/2
BSR 2 Speed Motors	£5/15/6
COLLARO 3 Speed Changers ..	£24/17/3
ACOS "GP20" Pick-ups ..	£6/3/6
NEON Indicator Pencils	16/-

Please allow sufficient for postage. Any surplus will be refunded.

HEADPHONES

The famous BROWN Type "X." A further shipment has just arrived and the price is lower than formerly. These are 2000 ohms and ideal for crystal sets.

38/4

Postage: NSW 1/10; Interstate 3/-.

HEADPHONES

Brand new ex disposals. A high grade low resistance head set complete with cord and plug. Not suitable for crystal sets. Phones of this type are now becoming scarce.

10/-

Postage: NSW 2/3; Interstate 3/8.

GENEMOTORS

American Dynamotors from "Command" receivers. Input—28 Volts, 1.1 Amps. Output—250 Volts, 60 Milliamps. Size—4½" x 2¾" x 3". These units have been used but are in perfect working order.

27/6

Postage: NSW, 2/11; Interstate, 4/4.

PRICE'S RADIO

5-6 ANGEL PLACE SYDNEY

IF YOU ARE BUILDING THE "1952 CAR SET" FEATURED IN THIS ISSUE USE THE FOLLOWING FERGUSON TRANSFORMERS

VIBRATOR TRANSFORMER TYPE No. VT104 (6 volt) or VT105 (12volt)

SECONDARY RATING—250 VOLT. DC. OUTPUT AT 60 m.A.

THE ASSOCIATE FILTER CHOKE IS TYPE No. CF-102

RATING — INDUCTANCE 15 HENRIES AT 60 mA.

Featured in the February issue was the "DUAL WAVE 1952 ADVANCE" receiver for which the following transformers are suitable.

POWER TRANSFORMER	FILTER CHOKE	OUTPUT TRANSFORMER
TYPE No. PF 151 A	TYPE No. CF 103	TYPE No. OP 24/2-1

FERGUSON

TRANSFORMERS PTY. LTD.

Telegraphic Address: "Fertran."

FERGUSON LANE, CHATSWOOD, SYDNEY.

Phone: JA2878

have the advantage of very moderate cost, even in the 1 pc range which is normally dearer than the 10 pc. In general, the instability becomes less noticeable as the resistor ages and, for this reason many people like to have their instruments checked after, say, 12 months, on the assumption that most of the worst drift will be over and it is then worthwhile to correct any small errors.

This is normally done by connecting additional resistors either in shunt or series with the one requiring correction. Drift in the correcting resistors is not important because they form only a small percentage of the total resistance.

SUITABLE RANGES

Special wire-wound types are inherently more stable, but are considerably more expensive and not very readily available. The ordinary wire-wound resistor is not ideal since it has appreciable inductance and is thus unsuitable for use with AC, while the higher values (.25 megohm) are not stock items. The correct type is non-inductively wound and, by using extremely fine wire, it is possible to produce values up to .25 megohm on a reasonable size former. However, such components are very expensive, probably costing up to 10 times as much as a carbon resistor of the same value.

The ranges chosen for this meter are those which long experience has shown to be the most satisfactory when the number is limited to four, and they will be found to be quite adequate for all normal service work. The multipliers will be 9.900 ohms (normally a 10,000-ohm resistor selected slightly on the low side), 50,000 ohms (50-volt range), and a .25 megohm for the 250-volt range.

The 1000-volt range is obtained by adding another .75 megohm to the 250-volt multiplier, making one megohm in all. It is not advisable to concentrate all this resistance in one resistor, due to the voltage coefficient of carbon resistors. This simply means that voltages above a certain value, usually 250, cause these resistors to change in value by several precent, an effect which is avoided by breaking the 1000-volt multiplier up into four units, each having only 250 volts applied to it.

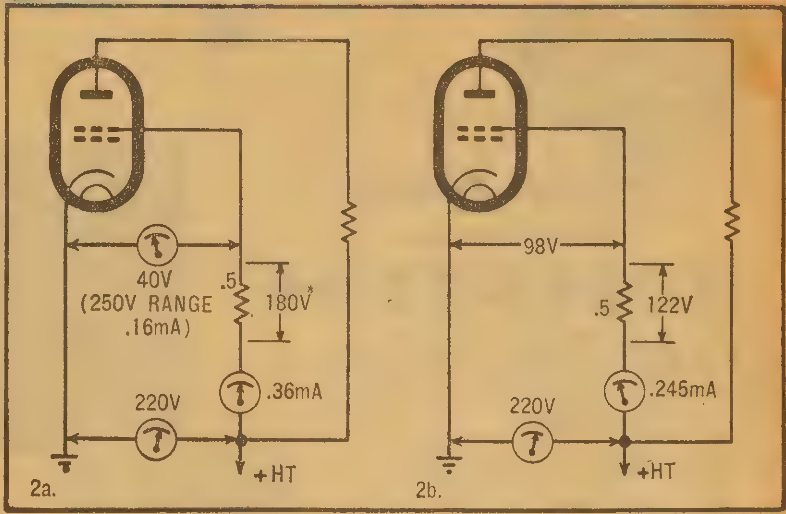
SENSITIVITY

The expression "ohms per volt" is frequently used with reference to meters and many bginners may be puzzled by it. It is really a convenient way of stating the sensitivity of the meter and this, in turn, is a function of the basic meter sensitivity, i.e., whether it is 50 microamps, 1 milliamp, or 10 milliamps.

The ohms per volt refers to the resistance of the voltmeter circuit compared with the number of volts required for full scale deflection. Thus, in the present case, we have 10,000 ohms in the 10-volt circuit, or a sensitivity of 1000 ohms per volt. Those of you who have been able to follow our brief mathematical discussions will realise that this sensitivity is inevitable for any meter with a 1 mA sensitivity.

On the same reasoning, a 10-milliamp movement will always give a sensitivity of 100 ohms per volt, while the 50-microamp unit will make it 20,000 ohms per volt.

HOW FALSE READINGS OCCUR



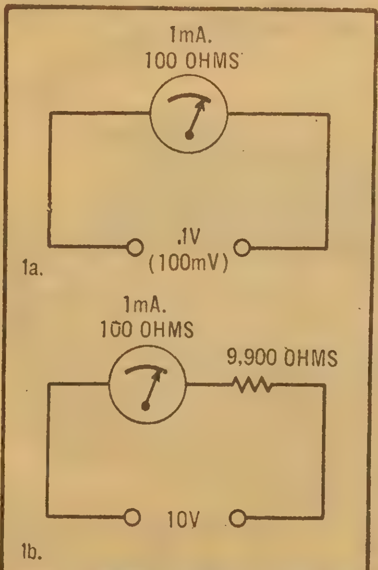
The diagram on the left shows how the current drawn by the meter reduces the voltage applied to the screen. When the current is measured and the voltage calculated (right) this error is eliminated.

And what is the significance of this sensitivity?

In many cases it matters little, while in others it is most important, and it needs some knowledge of circuit characteristics to appreciate which is which.

One approach is to compare the resistance of the circuit under test with the resistance of the meter, the former requiring to be much lower than the latter if an accurate reading is to be obtained.

Another way of looking at the problem is to consider the amount



These two diagrams show how the resistance of the circuit governs the voltage required to force 1 mA. through the meter. The resistance of the meter must be allowed for when calculating small multipliers.

of current required to give a full-scale reading and the ability of the circuit under test to deliver that amount of current. 1 mA is not a large amount and, at first glance you may imagine that most circuits could supply it without difficulty. Certainly an accumulator, a dry cell (even a small one), or the HT power supply for a set will hardly feel such a drain and there would be no cause to doubt the accuracy of the measurement in these circumstances.

However, there are other circumstances which are not so favorable and where the presence of the meter resistance can seriously upset the operation of the circuit. A typical case is the plate and screen circuit of a resistance coupled stage as shown in figure 2a. Readings taken from this circuit were as follows, the figures in brackets indicating the meter range used.

HT	220	volts	(250)
Plate	95	"	(250)
"	120	"	(1000)
Screen	40	"	(250)
"	60	"	(1000)

Note that the two ranges gave markedly different readings between the same points, thus raising the question as to which is correct. Before investigating this further let us make another approach to the problem. By measuring the current flowing through the plate or screen resistors we can calculate the voltage applied to them and when this is subtracted from the total HT voltage the remainder represents the voltage applied to, the plate or screen. Figure 2b.

CONFUSION!

In this case the plate current was .65 mA and the screen .245. Taking the screen conditions, we apply them to the formula for finding voltage which is: Current (in amps.) multiplied by resistance (in ohms). Substituting the values we get .000245 x 500,000, which works out to approximately 122 volts. Subtracting this from the HT of 220 volts leaves 98, the voltage on the screen.

This gives us three results for the same measurement; 40 volts measured on the 250-volt range of the meter, 60 volts on the 1000-volt range, and 98 volts by calculation. It is quite obvious that all three cannot be correct, so you may well ask if any of them are and, if so, which one.

First let's look at the conditions prevailing in the circuit without the presence of any meters. The screen resistor reduces the voltage to the screen by a certain amount because it has a certain amount of current flowing through it. If anything happens to upset this value of current the voltage applied to the screen will also change. Note also that the amount of current is very small, only .245 mA.

Now we connect a voltmeter between the cathode and the screen (figure 2a), providing a current path in addition to the normal path through the valve. The additional current will increase the voltage across the resistor and, since this current is comparable in value to that already flowing (actually .16 mA) the change in voltage will be considerable. When we use the 1000-volt range the resistance of the extra path is increased, the extra current drain decreased, and the circuit allowed to operate much nearer its normal conditions.

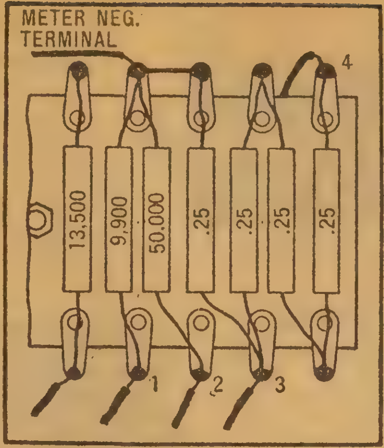
Nevertheless, there is still sufficient loading to cause appreciable error and although we may reduce this still further by using a higher voltage range, such a process cannot be carried very far since it reduces the movement of the needle until it becomes too small to take an accurate reading.

On the other hand the current measurement can be made without disturbing the circuit conditions to any appreciable extent, the meter adding only a few ohms to the existing value of several thousand and the effect is negligible. Thus the calculated voltage may be taken as the correct one, the readings taken with the meter having considerable error, even when taken on the highest voltage range.

If we were to use a 50,000 ohm per volt meter, the resistance would be very much higher and the loading on the circuit so light that, in most cases, it could be completely disregarded. While this is a decided advantage there are also disadvantages to these meters, such as a delicate movement more easily damaged than a less sensitive one, a more costly movement, and difficulty in providing stable multipliers in the high values required.

All this means that such an instrument, if it is to be satisfactory, will be considerably more expensive than the type we are considering; so much so in fact that it is only justified in special circumstances.

So popular has the 1000 ohms per volt type become that it is now regarded as virtually standard, and service data sheets issued by set manufacturers usually quote voltages which have been measured with this type of instrument. Likewise servicemen have come to accept the voltages indicated as being typical of resistance coupled circuits—even though they know that they are not the voltages ac-



This wiring diagram of the resistor panel will help in mounting the resistors. The numbers refer to the switch contacts.

PARTS LIST

- 1 O-1 mA. meter, 100 ohms internal resistance, universal scale S4-46A or similar, non steel calibration.
- 1 3 Bank 12 position switch with shorting type contacts.
- 6" of resistor strip having twelve contacts on each side.
- 1 Bakelite panel 8" x 7½" x ¼"
- 1 1000 ohm potentiometer.
- 1 1000 ohm 1 watt resistor 10%
- 1 13,500 ohm 1 watt resistor 10%
- 1 14.8 ohm shunt
- 1 166.6 ohm shunt
- 1 950 type cell
- 1 703 type battery
- 1 Pair test leads
- 2 Tip jack sockets
- 3 Pointer knobs
- Solder lugs, hook-up wire etc.

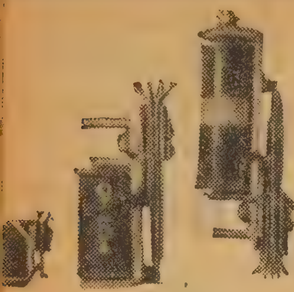
Additional parts

- 1 9,900 ohm 1 watt carbon resistor 1%
- 1 50,000 ohm 1 watt carbon resistor 1%
- 4 250,000 ohm 1 watt carbon resistors 1%

VOLTAGES

Voltages measured on Superhet Four receiver. All voltages referred to chassis.

1st electrolytic	
HT (2nd electrolytic)	220
Plate 6V6	205
Screen 6V6	220
Cathode 6V6	10
Plate ECH35 and 6AR7	220
Screens ECH35, 6AR7 and Oscillator plate ECH35 (1000V range)	85
Cathode 6AR7 (Maximum volume)	1.8
Cathode ECH35 (Maximum volume)	2.1
Cathode 6AR7 (Minimum volume)	23
Cathode ECH35 (Minimum volume)	24.5



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No. 2 Standard relay 250 x 250 ohm coil 4 pole S.T. 7/6

2 pole S.T. 6/6

No. 3 Standard relay 15,000 ohm coil, 2 pole D.T. .. 12/6

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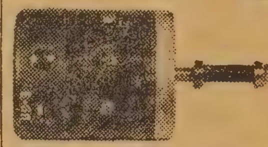

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tually applied to the valve—and regard them as correct only for this type of meter.

Coming to the more practical aspect of fitting the extra ranges we find that there is very little involved. From the photographs you will see that the multipliers are mounted on the right hand side of the terminal strip, alongside the 13,500 ohm resistor belonging to the ohmmeter circuit. To assist in mounting these as in the original we show the layout in a small wiring diagram.

The circuit also shows how these should be connected, the switch positions being 1, 2, 3, and 4 and the deck being No. 1 or that nearest the panel. There is also some additional wiring to No. 3 deck, positions 1 to 4 requiring to be linked together.

WIRING

Contacts 1, 2, and 3, on No. 1 deck are connected to three lugs on the lower edge of the panel to which are connected the first three multipliers. The fourth contact goes to the terminal at the upper right corner of the strip, this being the most convenient way to accommodate the three additional resistors for the fourth multiplier. The wiring is completed by taking a wire from the negative meter terminal (left hand, rear view) to the two lugs on the upper side of the panel to which the other side of the multipliers are connected.

When soldering the pigtails of the multipliers it is important that the body of the resistor not be unduly heated, for this can cause a change of value. The normal soldering process will usually apply more heat than is desirable and it is a good idea to quench the joint as soon as it has set. The best way to do this is to have handy a cloth soaking in a small open dish of methylated spirit. As you replace the iron pick up the cloth and, as soon as the solder sets apply the cloth to the joint squeezing a liberal quantity of spirit over it.

The rapidly evaporating spirit will cool the joint quickly, while this same fact prevents any chance of unwanted after-effects. The same general technique may be used to prevent plastic insulation from melting when wire is being soldered, the cloth in this case being used to hold the wire while the joint is made.

PRELIMINARY CHECK

With all the wiring completed, check it carefully and, if quite satisfied, you can make a rough test by measuring any available voltages, the value of which is approximately known. A good source is a dry battery which should have a voltage of about 1.6 per cell when new.

Don't try to read the voltage of the ohmmeter batteries while they are still connected in the circuit, or you might quite easily damage the meter. It is as well to use low voltage sources for your initial test, since there is less chance of damaging the meter if something is not quite right. If these appear to give approximately correct readings on the higher ranges, these may then be tried on higher voltages such as will be found in a receiver.

To give you some idea what to expect we are printing a list of voltages taken from the Superhet Four chassis, but any set may be us as a "guinea pig" if you have built this one.

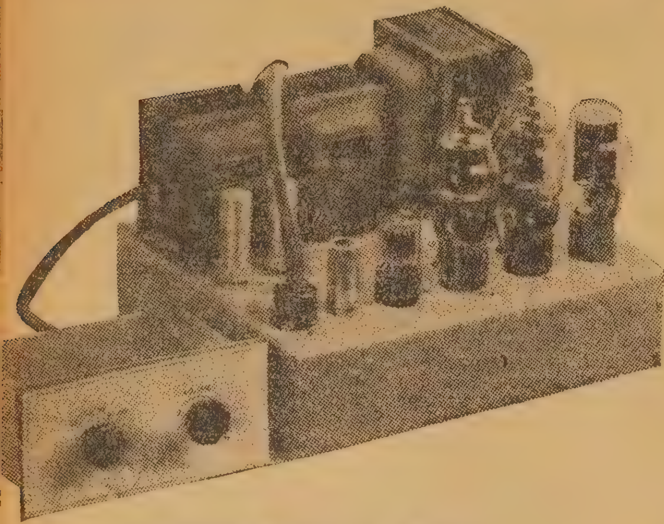
Some older type sets will pro ably have much higher voltages the early part of the power sup so, if in doubt, start with the hig est range and drop to a lower o if the first reading is low enou This is a golden rule to follow all times for it is all too easy overload your meter if you ad hit or miss tactics.

GRID BIAS

As well as the voltages shown suggest that you try reading the g bias on the 6V6. This will measured between the grid and cat ode and should be the same as t voltage measured across the cat ode resistor, ie, 10 volts. Howev you will find that the meter or indicates a very small voltage the order of .4 of a volt. This just another example of errors cau ed by high resistance in the circ under test, the offender in this ca being the .5 megohms grid resist

In this case the reading you o tained at the grid of the valve w indicate that the grid resistor is i tact or, better still, you can check with your ohmmeter. If it is inta the voltage applied to the grid m then be taken as being that d veloped across the 6V6 cathode r sistor.

Build your own MICROGROOVE AMPLIFIER



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Amplifier No. 3 (R. & H. Jan. 1952) 4W output.
Amplifier No. 4 (R. & H. Dec. 1951) 4W output.
Control Unit No. 1 (R. & H. Oct. 1951) for use with amplifiers 1, 2, 3.

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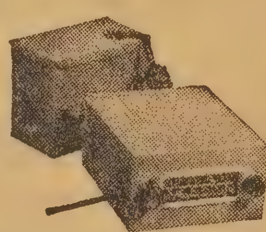

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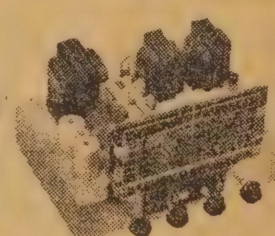

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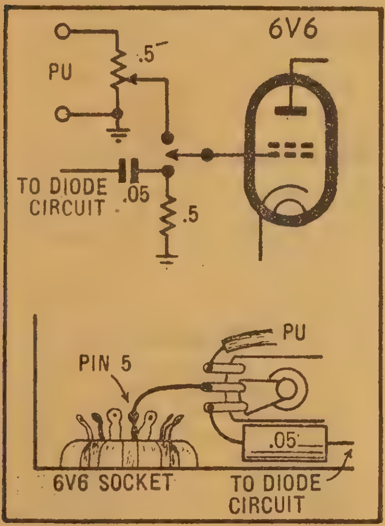
Since publication of the Superhet Four we have received several letters asking whether it is possible to operate a pickup in conjunction with this set and, if so, how to go about it.

AT first we were inclined to advise against the idea, or, at least, against that of buying any expensive equipment on the assumption that it could be used with this set. Actually, we have published record player circuits in the past, using only an output valve and power supply, and which had sufficient sensitivity to operate from a high output crystal pickup.

The output stage of this set is of a similar type, but we had some doubts about the output of the modern lightweight crystals compared with the older (and heavier) variety.



Follow this diargram and you should have no difficulty in adapting your "Superhet Four" for use with a crystal pickup.

Anyway, to cut a long story short, we decided to try it, and were rather surprised to find that, while the output of a GP20 was less than that of one of the older models, there was still sufficient to make quite a lot of noise. As a matter of fact a heavily cut 78 rpm record can be uncomfortably loud in an ordinary room, and will indicate the need for a volume control.

Such a control can take the form of a .5 megohm potentiometer mounted on the motor baseboard. This provides the correct load for the crystal pickup, which is desirable for best results, particulaly at the bass end, and can also become the grid resistor for the 6V6.

To achieve this it will be necessary to fit a small switch to change the grid connection from the existing internal grid resistor to the external potentiometer. The way in which this is done is shown in the accompanying circuit, the switch being a simple single pole two position type.

While at first it may appear that this may be conveniently mounted on the front of the chassis there are some objections to this idea. The main one is that leads from the 6V6 grid circuit would have to run close to the converter socket and adjacent wiring, with possible trouble in the form of instability. A better scheme seems to be to drill a hole in the rear of the chassis and mount the switch close to the 6V6 socket, thus keeping lead length to a minimum.

Connection to the pickup can be either through terminals, also on the back of the chassis, or, if you wish to retain this space for extension speaker terminals, through a short length of shielded cable. In the latter case it might be more convenient to mount a pair of terminals on the motor board near the pickup base.

HIGHER GAIN

Although results from the 6V6 were adequate with heavily cut records, there was hardly sufficient gain for use with some of the lightly recorded discs and some reserve would have been useful, suggesting that higher gain valves, such as the EL3, EL33, 6M5, or the KT61 will provide a worthwhile improvement. With the exception of the last-named these valves require a bias resistor of 150 ohms while the KT66 requires 90 ohms.

However, watch the physical size of these valves as there is not a great deal of room behind the gang. We were able to juggle an EL3 into place by moving the position of the socket slightly, but there was hardly enough room and the valve had a decided list to port, which would not be very satisfactory as a permanent arrangement.

Finally, note carefully that only high output pickups, such as the crystal types, are suitable for use with this simple circuit. Some of the very old magnetic types may give results of a kind, but the modern lightweight magnetics have very low output and are completely unsuitable for low gain circuits.

WE HAVE NOTICED:

- That some people have the idea that sapphires wear records worse than anything else. The reverse is just about true. Use a light pickup and a good sapphire and the wear will be smaller than you can manage any other way. Semi-permanent steel needles in heavy pickups are the worst ever.

- Readers frequently ask whether a 100mA power transformer can be used in place of an 80 milliamp transformer. Of course it can, provided the voltages are the same. You can carry a bag of cement in a utility, but there is no objection to using a five-ton truck if that's what you happen to have. But you can't load an 80 milliamps "tranny" with 100 milliamps with any more safety than you can load a small utility with tons and tons of lead.

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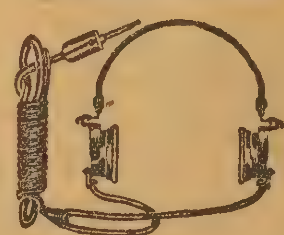

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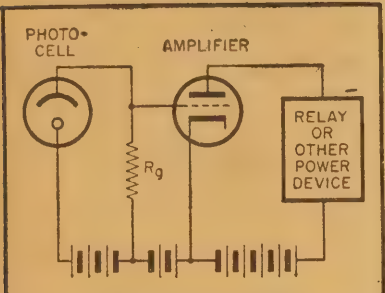
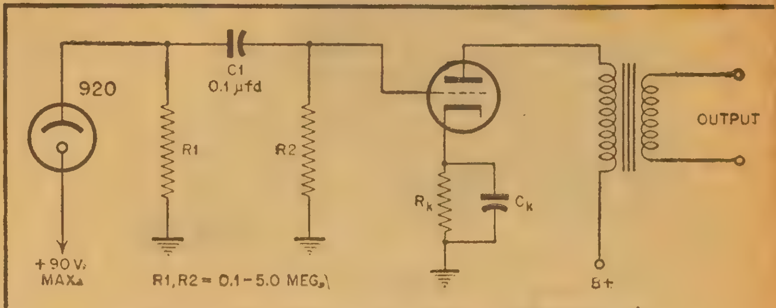
TYPICAL CIRCUITS FOR PHOTOTUBES



TYPICAL PHOTOTUBE AMPLIFIER CIRCUIT
FIG. 1



PHOTOTUBE CIRCUIT FOR SOUND REPRODUCTION
FIG. 2

Because they are sensitive to light and shadow, photocells find wide application nowadays in industry, counting and inspecting products, protecting personnel, controlling illumination. This paper, contributed by Aerovox Engineers, describes the operation of typical photocell control circuits.

THE photoelectric cell, or "electric eye," as it is often referred to, has many applications—from use in burglar alarms and smoke detectors to facsimile, television, and even the measurement of microscopic tissue cells. It is based on a discovery by Hertz in 1887 that emission of electrons can be caused by light striking the surface of certain materials such as sodium and potassium.

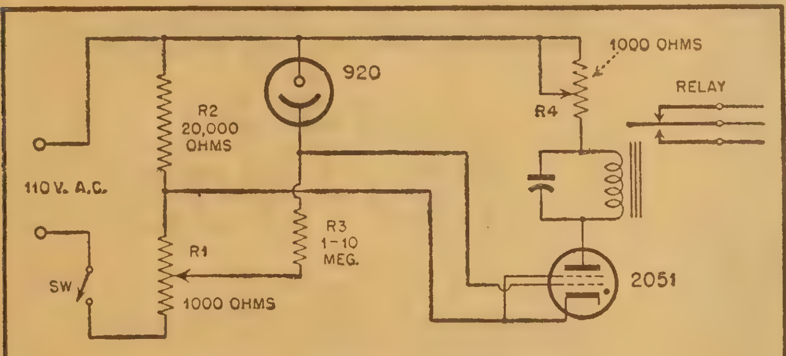
Photosensitive devices fall into three general classes: (1) photoelectric or "phototubes," (2) photoconductive cells, and (3) photovoltaic cells.

Phototubes are those in which impinging light causes emission of electrons from the photosensitive surface. Most practical photo-sensitive devices, such as the burglar alarm, automatic counter, door opener, and smoke detector, fall in this category.

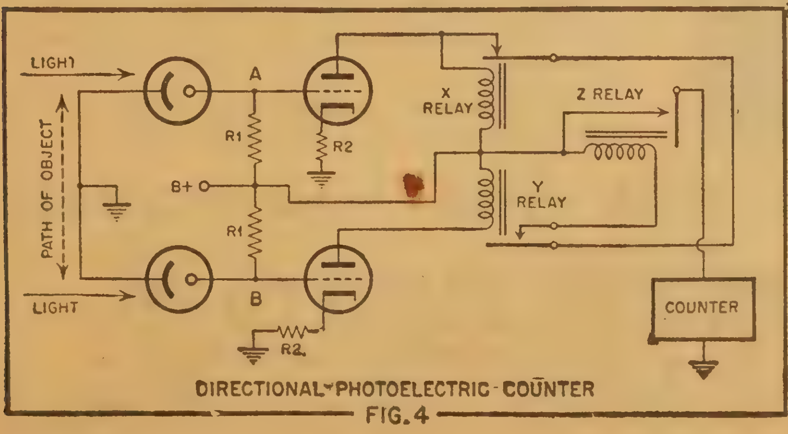
Photoconductive cells are those in which the internal resistance varies with the amount of light striking the sensitive surface. These cells ar used to operate very sensitive relay and in the measurement of infra-re radiation.

Photovoltaic cells are those whic generate an internal emf upon ex posure to light. The ordinary ligh intensity meter used in photograph employs a photovoltaic cell connecte directly across a low resistanc meter.

Commercial phototubes are essen tially diodes contained in glass en velopes very similar to those use for thermionic vacuum tubes. Th cathode is usually a large semi-cylir drical surface coated with a photo emissive material. The anode is wire lying parallel to the cathoc axis.



P.E. CELL LIGHTING CONTROL CIRCUIT
FIG. 3



DIRECTIONAL PHOTOELECTRIC COUNTER
FIG. 4

GASEOUS TYPES

These elements may be enclosed i an evacuated bulb, or one which gas-filled. Gas-filled tubes are em ployed largely in motion picture wor where their higher sensitivity re duces the amplification needed. Hig vacuum phototubes are used in ligh measurement work and in certai relay operating applications. The are less subject to damage due application of excessive voltage c current, and their sensitivity remair more constant over a period of tim

The most common applications c phototubes involve the use of asso ciated vacuum tube amplifiers, as i Fig. 1. The tube is coupled to th input of an amplifier by means of large resistance, Rg. Since the cur rent flow through the cell is of th order of a few microamperes, this re sistance should be very high.

By proper amplifying circuits, th current in the final output stage c the amplifier may be sufficient t operate a relay or a loudspeaker a in the sound picture industry. Se Fig. 2.

Another valuable application of th photoelectric cell is the control c lighting. The tube is used with a amplifier and relay to turn the light ing system on when daylight de creases and off when natural light again adequate.

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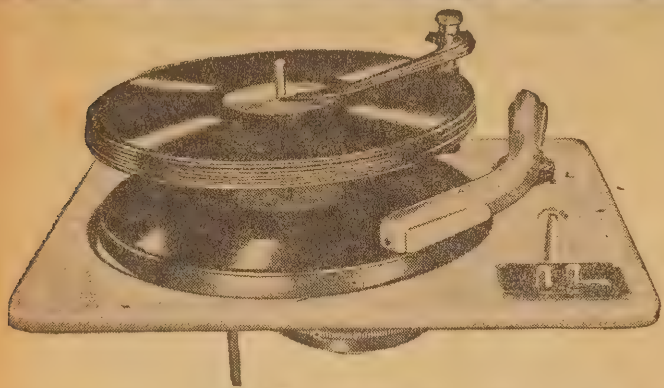

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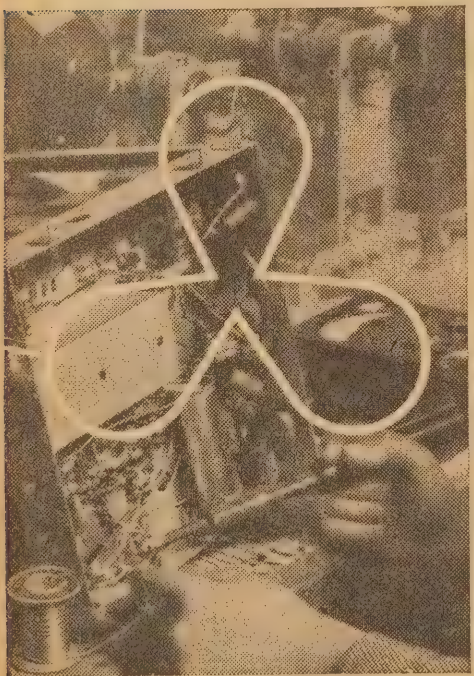

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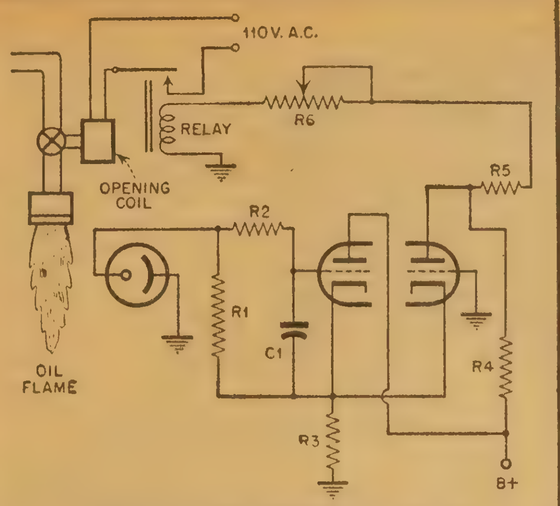
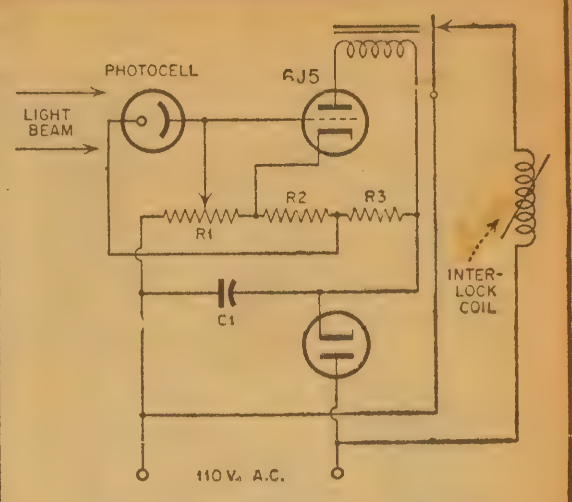


FLAME FAILURE PROTECTIVE CIRCUIT
FIG. 5



"LIGHT CURTAIN" PROTECTIVE CIRCUIT
FIG. 6

Fig. 3 illustrates a circuit in which the relay is energised by an increase in light. As long as the illumination on the phototube is below a certain value, the 2051 grid potential is below cut-off and prevents conduction. When illumination rises, grid voltage is made less negative and the tube conducts, closing the relay. The function of R4 is to keep the current through the 2051 within the tube's maximum rating.

NO DC CIRCUIT

Note that this circuit works directly on AC line voltage, requiring no DC supply.

The simplest use of the phototube and relay is that of counting. A beam of light is interrupted by one conveyor belt into a photolectric tube which operates a counter. When the beam of light is interrupted by one of the objects to be counted, the change in tube current operates the counter.

An interesting circuit of this type is the one-way counter illustrated in Fig. 4. This arrangement records objects passing in one direction, but not in the other.

Suppose an object is passing downward in Fig. 4 so that it obscures phototube A and then B. When the light to tube A is interrupted, plate current flows in tube X, opening the contacts of relay X. As the object continues downward, both tubes are obscured and relay Y closes. But since the contacts of X relay are open, no current flows through the Z relay and the counter is inoperable.

Now suppose that the object passes from B to A. Relay Y is operated when amplifier tube B starts to conduct. Then, when the object obscures both phototubes, the current through the amplifier tube associated with phototube A passes mainly through the contacts of relays X and Y to operate the Z relay and the counter.

Relay X does not operate and its contacts remain closed. Thus, the counter is actuated only by objects passing in the direction from B to A.

The applications of photoelectric cells to safety devices are very numerous. Some of the more familiar safety controls are the smoke detectors, traffic control, and protective door openers which prevent automatic doors from closing until personnel are clear.

ANOTHER CIRCUIT

Another important protective circuit of this type is the flame-failure detector shown in Fig 5. This device, intended to safeguard oil furnaces, uses a dual triode as its principal element.

When light from the flame is present, photocurrent flows and the first triode section is blocked. The second section normally conducts current enough to close the relay which opens the solenoid oil valve and allows the flame to burn.

Should a flame failure occur, the photocell no longer provides blocking voltage to the first section which then conducts and applies a blocking voltage to the grid of the second triode section. The blocking of current in the second triode opens the relay and closes the oil valve with the simultaneous ringing of a[n] alarm bell.

An even more common kind of in[-]dustrial safety control is the "ligh[t] curtain" type of protective devic[e] used to safeguard the operators [o]f heavy machines. In this applicatio[n] of photoelectric devices, a light cur[-]tain is formed about the area of dan[-]ger by a series of beam projecto[rs] and mirrors, the beam falling ulti[-]mately on a set of phototubes.

If the operator inadvertentl[y] reaches into the protected area, on[e] of the beams of light is interrupte[d] and the machinery is stopped by a[n] interlock operated by the photoce[ll] relay.

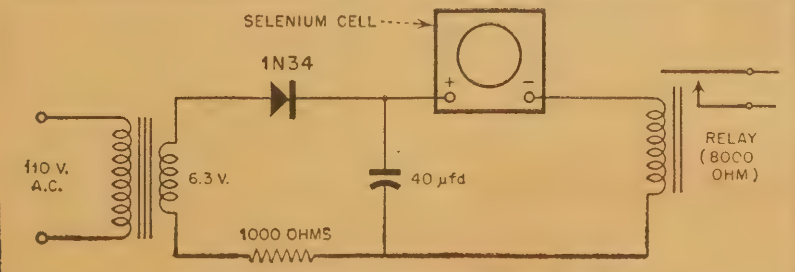
Fig. 6 is a typical circuit of thi[s] kind. Here the bias potentiomete[r] (R) is adjusted to cutoff so that th[e] 6J5 does not conduct in the absenc[e] of light on the photocell cathod[e]. With incident light the photocurren[t] through this bias resistor causes th[e] tube to conduct and operate its loa[d] relay which, in turn, operates an in[-]terlock which permits the machin[e] to operate.

STOPS MACHINE

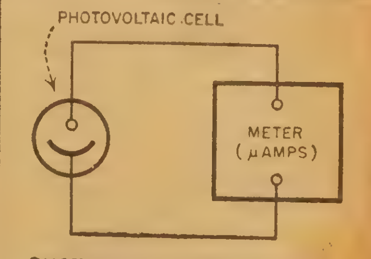
Interruption of the incident ligh[t] beam causes the 6J5 to cut off an[d] stops or delays the operation of th[e] machine. A safety control of th[is] type is most frequently used wit[h] punch presses.

Phototubes also find many applica[-]tions in the measurement of tim[e], distance, thickness of materials, &[c]. A photoelectric device can be mad[e] to operate as a micrometer for raz[or]

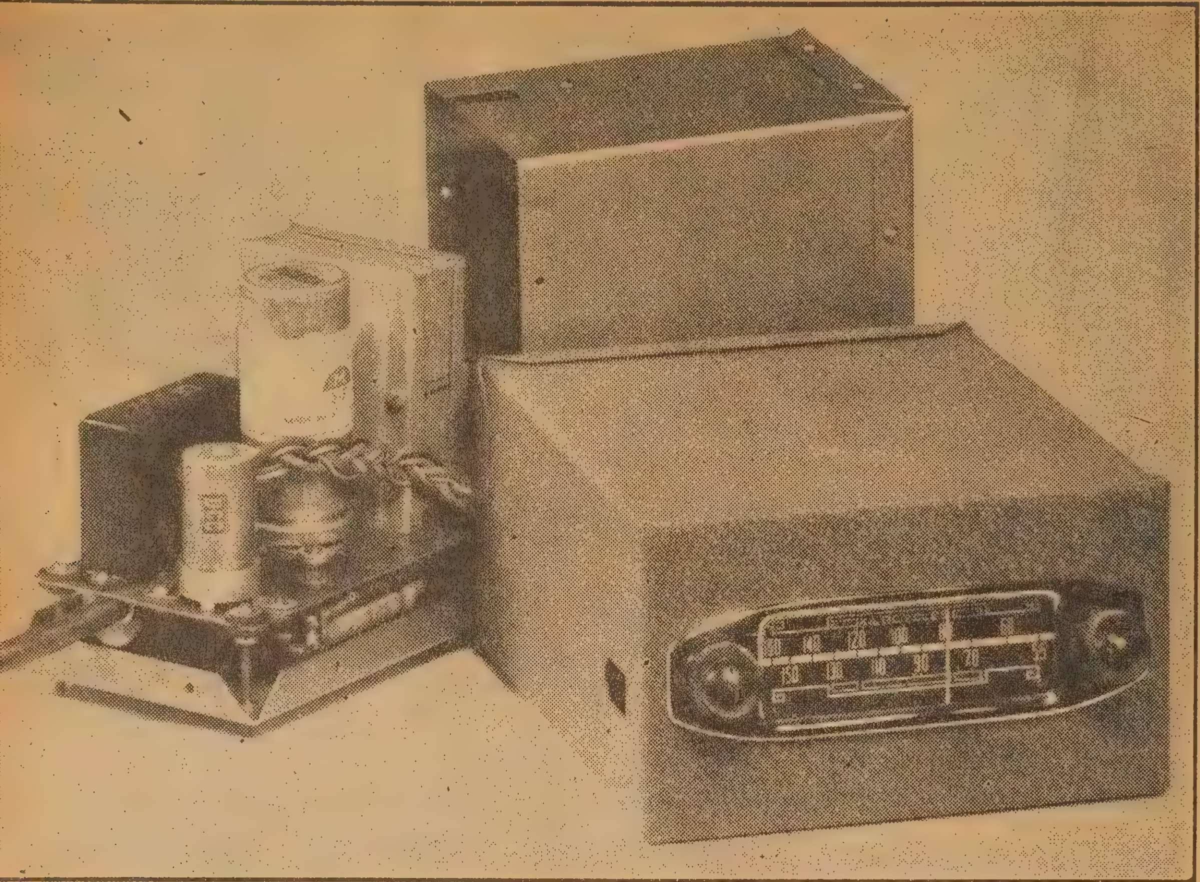
(Continued on Page 110)



SIMPLE PHOTOELECTRIC CELL CIRCUIT
FIG. 7



PHOTOVOLTAIC CELL CIRCUIT
(EXPOSURE METER)
FIG. 8



Our new "Karset," with power supply cover removed to show he major components. Tuning knob is on the right, volume and off-on switch on the left.

PRESENTING THE 1952 'KARSET'

Perhaps you've been wanting a car radio for a long time. Maybe, you've not been able to obtain constructional data. This article is designed to solve your problem—a full description of our now-famous "Karset," modifi ed to use the latest components. It retains its high performance and its ease of adaption to cars of all types.

ACK in the May, 1949 issue of Radio and Hobbies we took a ep in the dark and described the rset radio for the benefit of home nstructors. It appears that we hit e proverbial "jackpot," for literally ousands of these sets were constructed and fitted to cars of all types, es and shapes.

The two-unit idea appealed well, cause it allowed variations in ounting to suit individual circumnces. In some cases even the tuner rtion was used with a commercialpe vibrator supply, in others with a nerator supply.

Since the description of the original rset was published we have been undated with requests for copies the issue, requests which could be t only until the supplies of that rticular issue became exhausted. These requests are still being made. We are thus faced with the decision either of reprinting the old circuit diagram and associated details or of dressing-up the old design so that it would be in keeping with currently-available components.

There were a couple of other points also which required consideration. Vibrator "hash" interference had been encountered by some constructors, although in a number of cases this had been due to liberties taken with layout and wiring without due consideration to the problems involved. Nevertheless, another approach was indicated, one which would be less critical as regards the inevitable small changes which creep in on a home-constructed unit.

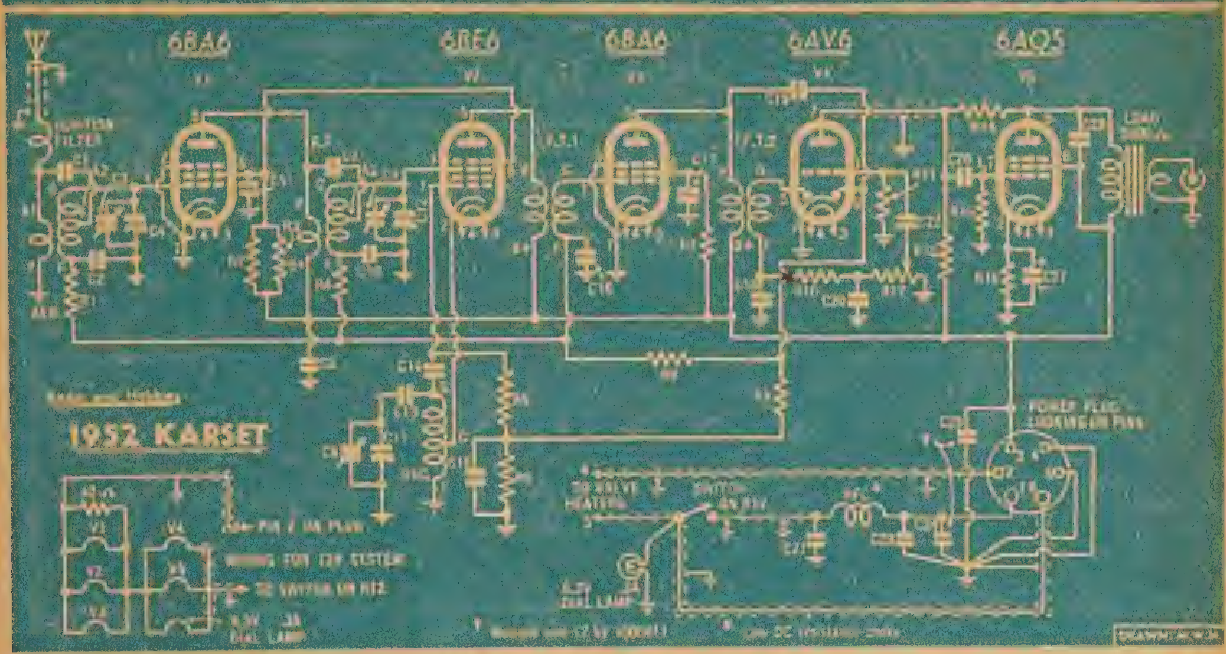
by Raymond Howe

We found also that the ready-made chassis as purchased in the shop generally required a little preliminary work in order to fit current components into their respective places.

Summing up the situation we decided upon a revised design which, while retaining the essential features of the original set, would allow us to illustrate the use of more suitable components now available, to concentrate on the problem of vibrator "hash" interference and to arrange for a more accurate ready-made chassis.

The finished set has an overall

THE CIRCUIT OF OUR NEW CAR RADIO RECEIVER



Here is the circuit of the receiver unit, coded to correspond with the parts list below and with the coded photograph. With special aerial coil, C1 is contained within the can.

performance even better than the old design. Vibrator "hash" should not constitute a problem provided that the exact layout and wiring as illustrated in these pages is followed. We know that this technique which we have adopted does work and work well, as it did from the start. We had the set, uncased, working alongside the vibrator supply and in its most sensitive condition, with the volume turned well up, there was no trace of "hash" interference. But more of this anon.

Recapitulating in brief upon the design, the set consists of three units, two of the units as mentioned earlier being the set proper and the vibrator power supply. The separate speaker makes up the third unit. It is impossible to include the speaker within the set itself because it is highly desirable that a reasonably-sized speaker be used.

The set can be slipped completely into the glove-box or mounted behind or under the lip of the dash panel. The power supply can be fitted to a side panel or bulkhead or even attached to the back of the set with a

PARTS LIST

- 1 Chassis 6" x 5¾" x 1" and box 6½" x 3½" x 7" (for receiver).
- 1 Base plate 3½" x 5¾" and box 6" x 3½" x 5" (for power supply).
- 1 Car radio coil kit comprising Aer. and RF coils with tapped secondaries, Osc. coil to suit 6BE6 valve, two 455 kc IF transformers and ignition suppressor coil
- 1 Miniature dial (MSL/48 B/C) to suit gang.
- 1 Miniature 3-gang tuning capacitor (C4, C11, C12).
- 3 Small trimmer capacitors (C3, C8, C9).
- 1 6 or 12 volt vibrator transformer with 250v. 60mA. secondary.
- 1 Synchronous vibrator cartridge 6 or 12 volt to suit transformer.
- 1 15 henry 60mA HT filter choke.
- 5 miniature valve sockets with shield cans.
- 1 6-pin valve socket for vibrator.
- 1 6-pin valve socket with cover.
- 1 6-pin plug (chassis mounting type)
- 1 High frequency RF. choke (may be in coil kit).
- 1 7" or 8" speaker with 5000 ohm speaker transformer.
- 2 Chassis-mounting single contact plug and socket assemblies (car radio type).

VALVES

2 6BA6, 1 6BE6, 1 6AV6, 1 6AQ5.

CAPACITORS

C1 100 pf
C2 .05 mfd
C3 Trimmer
C4 Gang section
C5, C6 .1 mfd
C7 100 pf
C8, C9 Trimmers
C10 .05 mfd
C11, C12 Gang sections
C13 425 pf 5% mica
C14 100 pf
C15, C17 .1 mfd
C16 .05 mfd
C18, C19, C20 100 pf
C21, C23 .1 mfd
C22 .01 mfd tub.
C24, C25 2 by 1000 pf (UCC multiple unit)
C26 .01 mfd tub.
C27 25 mfd 40PV miniature electro.
C28 .005 mfd tub.
C29 .1 mfd.
C30 1000 pf UCC miniature.
C31, C32 .01 mfd 600WV tub.
C33, C34 8 mfd 525 PV electrolytics.
C35 .5 mfd 200 or 400WV tub.
C36, C37 2 by 100 pf (UCC multiple)
C38 .1 mfd.

The 100 pf are UCC miniature (or similar). The .1 mfd and .05 mfd can be TCC 350v. tub. or 200v. Aust. The .01 mfd are TCC 500v. tub.

RESISTORS

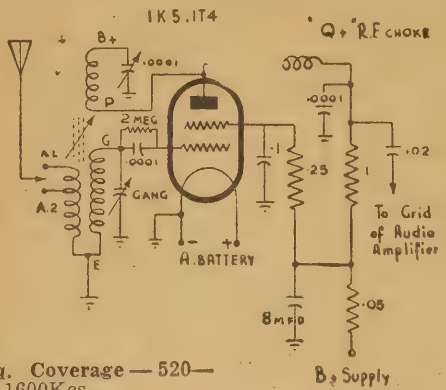
R1, R4 .1 meg. ½ watt
R2, R3 .025 meg. 1 watt
R5 .02 meg. ½ watt
R6 3000 ohms ½ watt
R7 .05 meg. 1 watt
R8, R9 1 meg. 1 watt
R10 .1 meg. ½ watt
R11 10 meg. ½ watt
R12 .5 meg. potentiometer with switch
R13 .25 meg. ½ watt
R14 2 meg. ½ watt
R15 .5 meg. ½ watt
R16 350 ohms 1 watt

SUNDRIES

2 Small knobs and felt washers. 1 6.3 volt dial lamp, 2 5-tag, 1 4-tag, 1 3-tag and 1 2-tag mounting strips; small quantity 16 gauge B&S enamelled wire for RF chokes; aluminium scrap for brackets; PTIM coaxial cable for aerial lead; about 2 yds. shielded wire; 2 ½" threaded stand-off pillars; 1 ⅜"i.d., 2 ¼"i.d. and 5 3/16"i.d. rubber grommets; fibre or bakelite washers for insulating support bolts from supply internal plate, solder lugs and solder; nuts, bolts and lock washers; hook-up wire.

RC 8

STANDARD SIZE B/C REINARTZ COIL



Freq. Coverage — 520—1600Kcs.

Physical Size — 1⅜" diam. x 2¼" high.

Pin Connections

1=Grid.
2=Long Aerial.
3=Pri.+Sec. Earth.
4=Plate.
5=Short Aerial.
6=B+ or reaction C.

Tuning Capacity
(With stryas.)
25-445uufd.

Primary Inductance
Long A=1.MH.
Short A=2.MH.

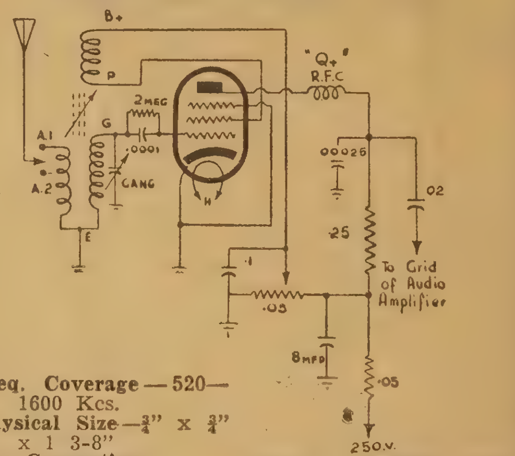
Secondary Inductance
At 1000 Kcs.—210 uH.

REMARKS

Construction of 7/41 litz with tapped primary providing a means of matching long or short aerials. Coils "Q" and gain are not stated as they vary with different circuit conditions.
Although a battery circuit is shown a typical AC circuit is shown under type RC6

RC 6

MIDGET B/C REINARTZ COIL "SPHEROCLAD CONSTRUCTION"



Freq. Coverage — 520—1600 Kcs.

Physical Size —¾" x ¾" x 1 3-8"

Pin Connections

P=Plate.
B+B+ or Reaction C.
F=Secondary + Primary Earth.
G=Grid.
A1=Short Aerial.
A2=Long Aerial.

Tuning Capacity—with strays 25—455 uufd.

Primary Inductance
Long A=1. MH.
Short A=2. MH.

Secondary Inductance
At 1000 Kcs. — 210 uH.

REMARKS

Construction is of 5/41 litz secondary with tapped primary providing a means of matching long or short aerials. Coils "Q" and gain are not stated as they vary with different circuit conditions. Although an A.C. circuit is shown the RC6 coil is suitable for use with battery valves and a typical circuit is shown with type RC8 Reinartz Coil.

"Q-PLUS"

RC 3

MIDGET B/C R.F. COIL WITH REACTION "SPHEROCLAD CONSTRUCTION"

Freq. Coverage—520—1600Kcs.
Tuning Capacity—25—455uufd. (Including strays.)
Physical Size = ¾" x ¾" x 1⅜".
Pin Connections—

P=Plate of first Valve V1.
B+=B+.
F=Secondary Earth.
G=Grid.
A1=Plate of V2.
A2=B+ or Reaction condenser.

Mounting—3/16" Whit. nut on to moulded insert in base—template supplied.

Secondary Inductance—when tuned to 1000 Kcs. 210 uH.

Primary Inductance—8.5 mH.

REMARKS

Construction is of litz secondary with suitable primary and reaction coils for R.F. stage with reaction work.

Coil gain and "Q" are not stated owing to the varying conditions met with but are substantially the same as for type RC1.

"Q-PLUS"

RC 9

UNTUNED B/C R.F. COIL OR 16 MH R.F. CHOKE

Inductance Value —16 MH.

Current Rating — 100 ma max.

Pins—Pigtail connections.

REMARKS

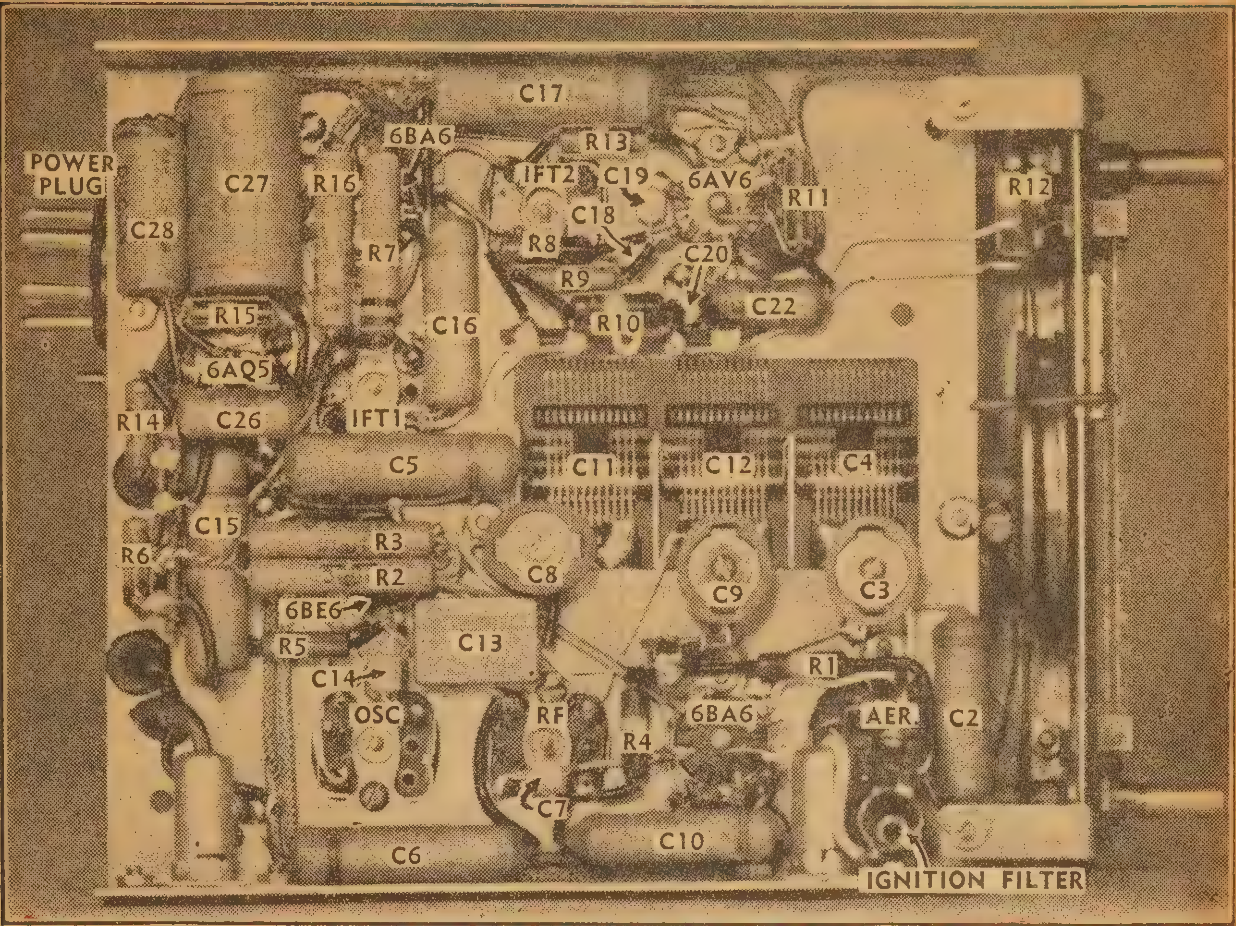
The type RC9 R.F. coil is designed for untuned R.F. stages in portable or other sets.

Operation is achieved by inserting same into plate circuit aerial stage valve to B+ and coupling a small condenser of about 100 uufd to the following grid It is mainly used in some commercial sets for replacement purposes.

R. W. STEANE & Co. Pty. Ltd., Auburn, Vic.

DUE TO PREVAILING CONDITIONS SPECIFICATIONS MAY CHANGE SLIGHTLY WITHOUT NOTICE.

UNDER-CHASSIS PICTURE OF CAR RADIO RECEIVER



Use of small components simplifies wiring problems. The tiny ignition filter coil at the top left is held in place by a stiff wire connection to the aerial coil.

pair of clips. This last thought was kept in mind in the original design of the set and supply.

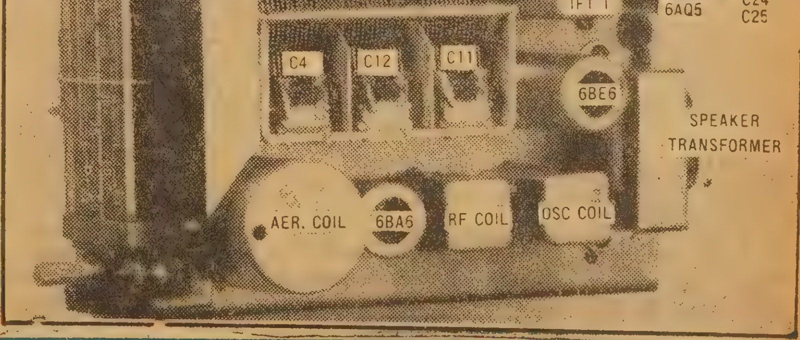
The choice of speaker size will depend largely upon installation limitations, although in many cases the desired 7in or 8in size can be accommodated, usually on the fire-wall or bulkhead. For positions behind the panel grille or on the header bar the selection of a 5in size will be more in keeping.

We arranged that this set should have no leads hanging from it, the necessary connections thereto being through plug and socket arrangement. The power supply plugs in at the rear and the incoming aerial and outgoing speaker leads plug in on one side.

The set employs five miniature valves, the stage sequence being RF stage, converter, IF stage, diode detector - AVC - triode audio stage, power output stage.

The now-standard car radio miniature coil kit is used in the main, the one exception being in the aerial coil. We took the opportunity of trying a new high-gain aerial coil marketed by one manufacturer and which is intended to feature increased coil gain with a consequent increase in the signal-to-noise ratio.

This coil is of standard size rather than miniaturised, but with slight modification to the can and the chassis it can be fitted. It is to be emphasised that this coil must not be replaced by the standard aerial coil of similar appearance. A standard coil would seriously affect the performance. If you are unable or do not wish to obtain one of these



A top view of the chassis. Note the large aerial coil just behind the tuning control.

special aerial coils use the standard miniaturised aerial coil associated with the car radio kit.

In other words, whichever aerial coil is used it must be one designed for use with a standard car aerial.

The remainder of the circuit follows along similar lines to that of the original Karset, there being no necessity to make any basic alterations.

Use of the miniature output valve allows us to mount a speaker transformer on the chassis, thus keeping the "hot" plate lead very short. The low impedance voice coil run to the speaker does not normally require shielding.

TYPES AVAILABLE

As far as we can gather the only transformer types which will fit into the available space are the Rola E type and the Jensen replacement type. When selecting, bear in mind the 5000-ohm optimum load requirement of the 6AQ5 and the voice coil impedance of your speaker.

Check on this transformer before you buy your speaker. If you are unable to get hold of one, purchase the speaker complete with transformer attached and connect it to the set through a short length of twin shielded cable, earthing the shield to the chassis of the set. You will naturally not be able to use the single circuit plug and socket suggested if you have to bring out the B-plus and plate lead.

The first step in construction would be to mount the gang and dial assembly. You will need to make up a pair of brackets to secure the gang to the chassis. When the dial is ready to fit into position, release the drum from the back plate and slip it on to the gang shaft, taking care to avoid tangling of the cord drive. A bracket plate between the dial and gang frame makes the whole a rigid assembly and provides support for the dial lamp.

SOCKET MOUNTING

Mount the valve sockets so that the gap between pins 1 and 7 is as follows.—V1 and V2 toward the gang, V3 toward the rear edge, V4 and V5 toward the adjacent side. Slip the 6AQ5 (V5) socket into place from underneath the chassis to give a little more clearance between the top of the valve envelope and the case.

Mount all coils with the "grid" pin closest to the gang. With the special aerial coil mentioned earlier, cut a slot in the can to make way for the dial drive spindle and cut a 1in dia. hole in the chassis to let the pins through. The latest version of the dial type used has a drive spindle of smaller overall size and will not necessitate a cutout being made in the coil can.

Place solder lugs under each bolt of each valve socket and under each bolt holding the aerial coil. Connect all such earth points together with a run of light-gauge tinned copper wire to avoid any future trouble from bad contact with the chassis. Use star washers under all bolts so that components will stay put under normal vibration.

First wire all valve heaters in parallel (for 6-volt operation) in shielded wire, earthing the braid at a number of points. If you have a 12-volt system in your car, wire the valve heaters as shown at the lower left of the circuit diagram and use a 12-volt vibrator cartridge and a 12-volt vibrator transformer in the power supply.

Note the route taken by the "hot" 6-volt lead. From the car accumulator, it enters the power supply case and passes immediately through the power cable to the set, through a filter circuit and via shielded wire to the on/off switch, the other side of the switch returning shielded to the power plug. From there, it passes to the power supply and through a "hash" filter to the vibrator transformer.

Watch for voltage drop in this 6-volt run. You may find it necessary to parallel two leads to make one in the run from the plug to the switch and back again. The "low d-c resistance" chokes (about 35 turns on a pencil) should be of about 16 B & S gauge.

From one side of the switch, a shielded wire feeds one side of the shielded heater circuit, the other side of the heater circuit returning shielded to the power plug, from where it is taken to the common earth point in the supply. Thus all 6-volt wiring within the set is in shielded wire.

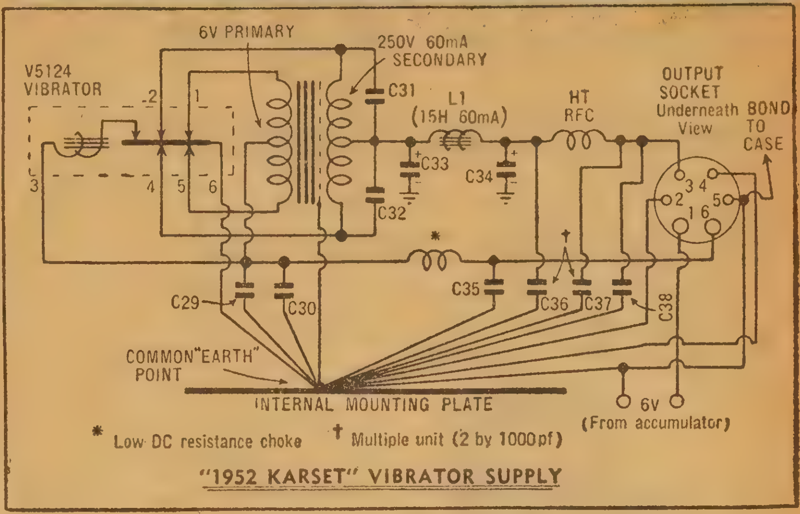
Earth the appropriate lugs and the centre spigot on each valve socket. Connect the return side of the 6BA6 (RF) heater directly to the solder lug under the adjacent bolt. This is important as it reduces "hash" getting into the sensitive first grid circuit.

Do not earth it to the centre spigot of the valve socket, even though this is already connected to the chassis. "Hash" interference results from high frequency currents generated within the vibrator supply and even a short length of wire common between one circuit and another can present sufficient impedance at these high frequencies to constitute undesirable coupling, particularly when one of the circuits concerned is the sensitive grid circuit of the RF valve.

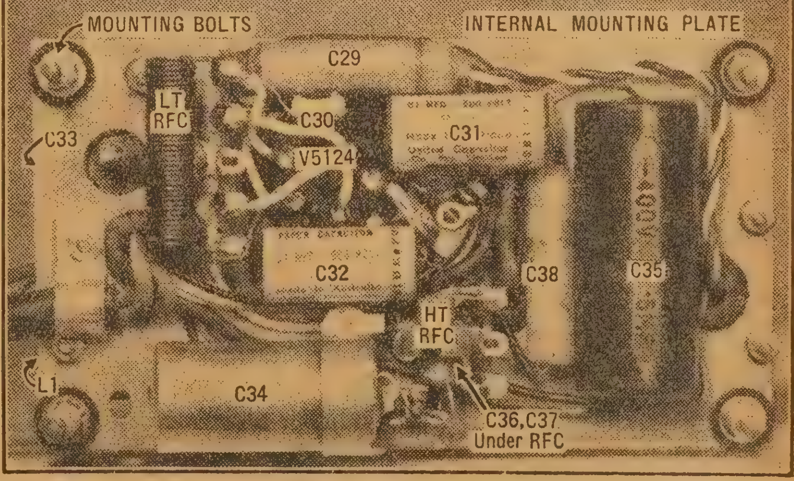
STAGE WIRING

Next, lay in the simple wiring runs, such as from coil to gang and valve socket, between IF transformers and from IF transformers to valve sockets. With the aid of the coded underchassis diagram, instal the other components more or less stage-by-stage, using tag-mounting strips where indicated to give the necessary rigidity of mounting.

CIRCUIT DIAGRAM OF POWER UNIT



The power supply is conventional but special emphasis is laid on the single-point earthing. Transformer connections must be phased to give positive H.T. output with the appropriate side of the L.T. circuit grounded.



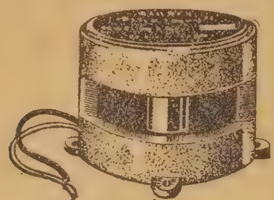
Underneath view of vibrator assembly plate, ready to slip into its shield case. Note insulated bolts in each corner. The electrostatic shield of the transformer should connect to the common "earth" point.

Homecrafts

100 CLARENCE STREET

TAPE RECORDER CONSTRUCTORS

We present for those experimenters who wish to construct their own tape recorders the following precision equipment.



Each head is supplied with free illustrated circuit diagram.

As illustrated

Model LI: Low impedance standard £8/8/0

Model HLI: Hi or low impedance HI-FIDELITY £10/10/0

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BSR MOTOR F.P.10

A 4 pole synchronous 240V A.C. or 110 volt. A.C. motor with 2in. shaft. Ideal for rewind motors.

Price £3/11/0

40 K.C. OSCILLATOR COILS — HIGH OR LOW IMPEDANCE 24/-

Continental High Impedance Head Phones

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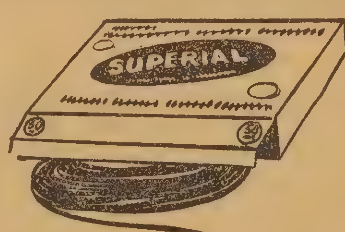


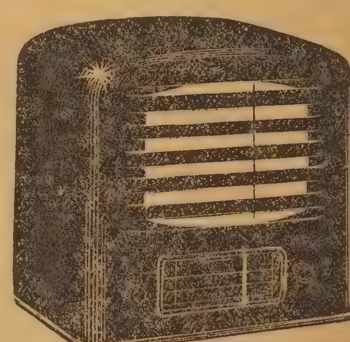
English Outdoor Aerial in Carton

50ft. steel & copper — 5/4

100ft. steel & copper — 10/8

100ft. pure copper — 13/5

All rubber and cotton covered.



KITSET

Bakelite cabinet with edge-lit dial. Ideal for the Custom Builder.

Price £3/8/-

Generators
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24 volt. 1500 watts £15/1/0

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Suitable for emergency power.

HOMECRAFTS

100 Clarence Street, Sydney.

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Also 26 Hunter St., Newcastle.

We have used miniature components where applicable and we strongly suggest that you follow suit. Note the multiple unit capacitor (2 x 1000 pf) at the input plug. These miniature units are ideal for RF bypassing where maintenance of exact value is not so important. The "double" units have three pigtails, the one coming out of one end being the common or earthy lead. The marked value of capacitance (within the accepted tolerance) is presented between each of the other two leads and the common lead.

When fitting the gang trimmers, make sure that the top plate is the one which solders to the chassis. The run from the 6AV6 to the 6AQ5 grid circuit is in shielded wire. The capacitance of the wire acts as an RF bypass, thus obviating the use of the usual "100 pf" capacitor found in other circuit diagrams at this point.

There is a point to watch here, however. There is available a type of shielded wire of small diameter. While it is satisfactory in certain applications, its rather large value of capacitance per unit length may, in the run involved, shunt the 6AV6 plate circuit excessively. It would be better to use the shielded hook-up wire of slightly larger diameter, which has a little more insulation between the inner wire and the shield braid.

VIBRATOR SUPPLY

The photographs of the vibrator supply show the layout of the components, a layout which aids the arrangement of a single earth point for the whole supply. Again note the use of miniature components and tag strips for wiring ease.

The "2 x 1000 pf" miniature multiple capacitor is underneath the high tension RF choke near the bottom centre.

The important points are the adoption of a common earth point (just to the lower right of the vibrator socket in the photograph) for all earth returns other than the 8 mfd electrolytics, and the insulation of the internal mounting plate from the outer case. The common earth point is obtained by securing a few solder lugs and a star washer under one of the vibrator transformer mounting lugs.

The 8 mfd electrolytics are of the chassis-mounting type. One is mounted on the top of the plate and the other mounted flat on the underside by bending one of its mounting lugs out straight, the other lug being snipped off.

The insulation of the plate from the case is arranged by using fibre or bakelite washers in and around the four corner holes of the plate through which the mounting bolts pass. Use star or spring washers under the nuts.

PHASING HT

For the initial trial of the completed supply, connect to the car accumulator with the earthed pole (i.e., earthed to the chassis of your car) going to the common earth point on the vibrator supply internal mounting plate. Check the polarity of the high tension output with a voltmeter, making sure that it is positive with respect to the mounting plate. If it is not, reverse the connections of the transformer secondary winding to the secondary contacts of the vibrator socket.

The vibrator supply case is bonded to the set chassis by a lead passing through the power socket and plug, and then connected to that pole of the accumulator which is attached to the chassis of the car. Thus, three leads go to the acumulator — the active lead, the return lead and the earth bond of the cases. You may later be able to dispense with the third lead, that is, the earth bond of the cases, although the extra lead does help to reduce voltage drop in the run from the accumulator.

Whether to shield or not to shield the cable to the accumulator is one of those variable factors. We found no need to shield this or the power cable to the set, so, providing that you use shielded transmission, such as PT1M, from the set to the external rod aerial, you will most likely meet with the same finding.

COMPONENT RIGIDITY

Remember that the shield braid of the aerial cable must be well bonded to the set at one end and to the car body near the aerial mount at the other end.

A bolt is secured to the modified power plug bracket, passing through the back of the case to hold the bracket and the set firm.

Rigidity of component mounting is of great importance. Check over the completed set and supply with this point in view. The one exception is the vibrator socket which should be mounted a little away from the plate on bolts passing through rubber-grommeted holes with a flat washer on each side. This reduces transmission of vibration to and from the cartridge.

You may need some sponge rubber in the case lid to hold the cartridge in place if rough roads tend to shake it loose.

If you have no aligning oscillator on hand, go about the alignment process in this manner: First see that there is equal overlap of the dial pointer at each end of the travel. Tune to the high frequency of the dial and select a station the frequency of which you know to be around the 1300 kc mark. "Peak" the aerial and RF trimmers. If necessary adjust the oscillator trimmer until the station appears at its correct posiion on the dial and "peak" the aerial and RF trimmers again.

COIL SLUGS

Now tune to a station toward the low frequency end of the dial, say around 600 kc. "Peak" the slugs in the aerial and RF coils. If necessary, adjust the slug in the oscillator coil until the station appears at its correct position on the dial. "Peak" the aerial and RF coil slugs again.

Return to the selected station at the high frequency end and readjust all trimmers in the manner mentioned until the station is received at best strength and at its correct position on the dial.

Now adjust the slugs in each end of both IF transformers for maximum volume. Go over these twice. You may find that you can get a "peak" at two positions of the slug. Select the "peak" which occurs when the slug is farthest out.

You will need to make the final adjustment to the aerial trimmer when the set is coupled to the car aerial and its associated cable.

We agree that the elimination of vibrator "hash" interference can be an exasperating business. It consists of such a wide range of frequencies that treatment which may be successful in one part of the circuitry

(Continued on Page 110)

FROM THE SERVICEMAN WHO TELLS

I have another item of test equipment for discussion this month, rather more specialised than previous ones, and I'm afraid that this has led me into a discussion bordering on a "How To Run Your Business" lesson. In the case history section there is a story of an amplifier which should have had a lot of watts, but didn't.

AS with last month's piece of test equipment, this month's — and probably most of those to come—is one of the "luxury" class. In fact, they might almost be classed as laboratory type instruments, and there may be some doubt as to whether there is really a place for these in the serviceman's workshop.

You may or may not agree in detail but, at least, my remarks may help up-and-coming servicemen to sort out their ideas on equipment.

From a purely servicing angle my doubts may be justified and the fellow whose sole source of income is derived from replacing screen resistors and electrolytics, may be wise to hesitate before investing in any "luxury" gear.

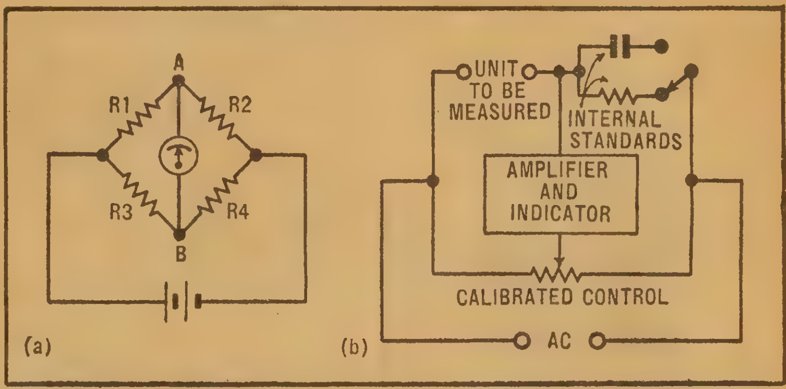

Figure 1. These two simplified sketches illustrate the principles of a measuring bridge.

OTHER JOBS

But this need not be your only source of income. If you are equipped for the work, there are many other avenues which will present themselves, such as the installation of PA systems, both permanent and temporary, in schools, churches, halls, sport grounds, &c., the wiring of offices and factories for intercommunication systems; or the building of special receivers, particularly radiograms, for the customer who wants something a little different from what is available commercially. Special clients are usually quite happy to pay well for individual service—quite apart from the interest value to yourself.

In large country towns, the serviceman will be more in the nature of an electronic consultant than a mere "fixer upper" of sets. He will be called upon to tackle anything from coaxing signals from a junior Marconi's crystal set to repairing Mr. Bill Smith's private telephone. And you will be well advised to tackle whatever type of job offers, if you think you can handle it, for just as valuable as the financial return is the excellent advertising they provide.

FREE ADVERTISING

The owner of a custom-built radiogram (bigger and better than any other in the district) will proudly show it off and extol its virtues at the slightest opportunity. Every time this happens you can hardly miss out on a free plug, for the listener is bound to ask who made it, if only to be courteous, and your stocks will be just that much better if the set really has something.

Likewise, a public address system will be heard by large groups of people and your name can be kept continually before them by being prominently displayed on all units of the installation. Once again, you have everything to gain—if your installation is a good one!

Which brings me to a pet grouch. Why is it that so many PA systems sound like an "aircraft-to-ground" circuit. There seems to be a popular idea that, because such systems are intended for speech only (which in itself is a fallacy, anyway) that anything goes. As a result, intelligibility, to say nothing of naturalness, are often hard put to it to survive.

DON'T LIKE IT!

Such a system is the worst possible advertisement for the person responsible. The general public may not understand the technicalities of the device, but they do know whether they can understand what is being said or whether a local identity's voice is recognisable as such. They will judge your ability as a technician on such results.

The pity of it all is that such results are quite unnecessary. Any modern amplifier circuit worthy of the name (and I don't mean a super laboratory, triodes-cum-100 pc feedback design) should have frequency response far in excess of that required and negligible distortion. Associated equipment, while it needs to be selected with care and in the light of the job to be done, need not necessarily be expensive, especially when the whole project can be regarded as a sound business investment.

And what is all this leading up to? Simply this. If you are going to undertake such jobs—and I think I have made a case for it—you will need to tackle a fair amount of simple design work. You will need to work in terms of impedance matching systems, frequency responses and compensating networks, power output calculations and measurements, and a host of others in similar style. You will also need the correct equipment, that is if you are to do a good job, and anything less than a good job just cannot be tolerated.


A typical commercial bridge for general service and laboratory work. It measures a wide range of "R" and "C" values, will provide polarising voltages for electrolytics and can be used as a comparision bridge with internal or external standards.

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CONTAINS —

Four UHF Triodes, Type 15E.
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The parts are worth considerably more.

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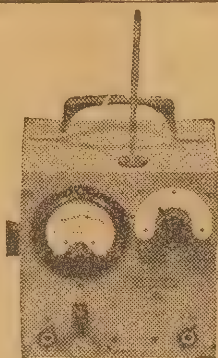

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Frequency range 100-130 m/cs or can be converted to any other freq. range by altering one coil. Complete with IN5G valve, imported 3-inch 0-1 MA meter and chrome-plated telescopic aerial. Jack provided for using meter for external measurements, also necessary plug and lead. Batteries encased within the unit. Size 6½ x 7 x 7 inches. Supplied in portable carrying case.
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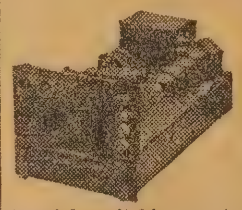

Complete with 11 valves: 2—RF stages, 954 acorns, mixer and oscillator, 2—955 acorns; 30 m/cs, IF channel, 4—6AC7's; detector 6H6; cathode follower 6AC7; rectifier 5V4G. Coaxial switching motors 24-volt DC. Frequency range, 160-190 m/cs.

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FULL WAVE BRIDGE TYPE

Ideal for AC Meters and Multimeters, etc.
PRICE, each 15/-
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956	12/6	VT90 Micro-pup	10/-
9001	10/-	6AC7	14/-
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EA50	7/6	7193	8/6
CV6	8/6	954	12/6

NEW VALVES

1S5	12/6	3S4	12/6
1T4	12/6	3Q4	12/6
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6C8G	14/-	83V	11/-
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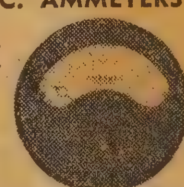

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DESIGN FOR HOME CONSTRUCTION

If, at the same time, these instruments are of value, even occasionally, in the ordinary routine service work, so much the better for, if they justify their existence in the building, of "specials," the assistance they provide for the service bench can be regarded as something of a gift.

One such item, then, is the resistance-capacity bridge. It cannot be regarded as entirely a laboratory instrument, for the ability to measure capacitance is something which can be of value in routine service work and, incidently, this is the first piece of equipment which I have described which provides this facility.

At first glance it may appear that there is little need for such a device, since most radio circuits simply require a large lump of capacitance and a variation of 20 pc either way is of no consequence. It is for this reason that most condensers are made with no better tolerance than this, except for a few values commonly used in tuned circuits, such as the ocillator padding condenser.

UNKNOWN VALUES

In practice, however, it is surprising how often one needs to know the value of a condenser which, for one reason or another, is either unmarked or about which there is considerable doubt.

One frequent cause of this is the method of marking used by some manufacturers, particularly on mica condensers, where the value is printed on the moulding with a rubber stamp. These markings are far from permanent and it often happens that a condenser can only be identified by the bin from which it is taken.

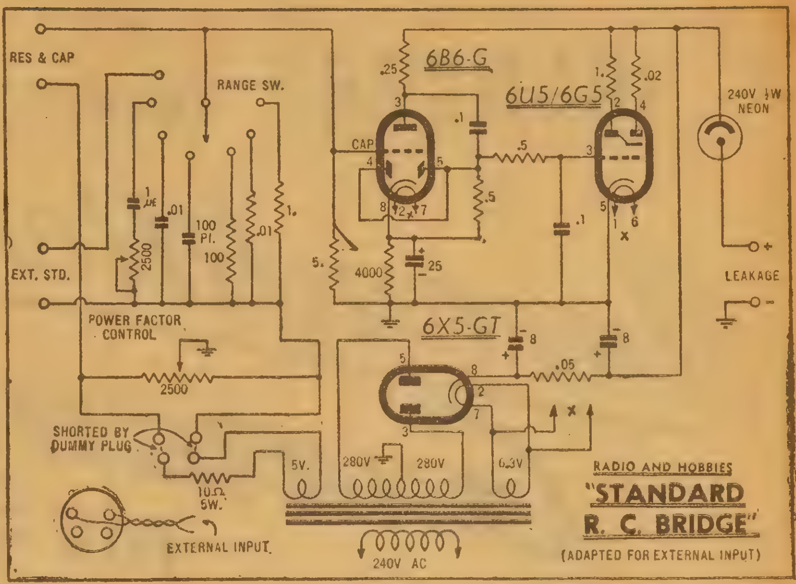
Once a few of these are scattered around the bench there is no way of knowing what their value is. Quite naturally, one is loth to toss them out, yet they are really of little use unless their values can be determined. What generally happens is that they are stored with other odd bits and pieces, pushed to one side every time an item of junk is being sought, and eventually finish up with broken pigtails. Then, of course, they have to be tossed out!

When repairing midget and mantel sets it is frequently necessary to remove many good components in order to reach the offending one and there is always the risk of a broken pigtail. Once again it is not unusual to find the values obliterated, presenting a rather difficult situation if the set is not a well-known one. Even though the condenser may be useless in the set it is usually possible to make good enough connection to enable it to be measured, if facilities are available.

OLD CONDENSERS

Again, when stripping down an old chassis, there are often many odd condensers which are worth salvaging, at least for use in various pieces of your own equipment, even if it is not advisable to use them in regular service jobs. Where there are facilities to measure these, their worth may be assessed immediately, the good ones kept, and the faulty ones discarded.

All these facilities may be regarded as valuable from the servicing angle alone, but the real value of the instrument will be appreciated when special circuits have to be evolved. This is particularly so in frequency compensating networks where condensers form a part of tuned circuits or frequency conscious dividing net-



An R/C Bridge, intended for home construction and described in the December, 1949, issue of Radio and Hobbies. The circuit is simple, the major difficulty being to obtain the accurate resistors and condensers specified.

works. For these the normal 20 pc tolerance of commercial units is hardly good enough, and some means of selecting from stock or measuring series or parallel combinations is necessary for best results.

As well as measuring actual resistance and capacitance values, these devices usually have means to indicate leakage in condensers, either by means of a neon lamp and a moderate HT voltage, or by balancing the leakage resistance with a calibrated resistor in the instrument. Sometimes both are provided.

This facility is an extremely valuable one, both for service and design work. Paper condensers often develop sufficient leakage to seriously upset the performance of critical circuits, even though it may still be many times greater than can be measured by most other means.

RESISTANCE VALVES

It may be argued that the ability to measure resistance is only duplicating what can already be done with a good ohmmeter. In part this is true, but the bridge method offers a greater range of measurement, higher accuracy, and the ability to use a known component as a standard against which others may be compared. In most commercial units the dial is calibrated directly in percentage tolerances to further aid this later measurement, which is also available for capacitance and inductance.

In case you're a trifle rusty about the operation of a bridge circuit or about how it is employed in devices of this kind, suppose we delve into a few basic principles. The simplest form of bridge circuit is shown in figure 1a, where the four resistors in the familiar diamond pattern are all of equal value.

Because they are equal there will be no voltage difference between points A and B, no indication on the met) and the bridge is said to be balanced. If R1 and R2 are an unknown resistor and a variable resistor respectively, we can balance the bridge by adjusting R2 until it is equal in value to R1. Now, if we have had the foresight to calibrate R2, the value of R1 may read directly, simply by adjusting R2 to balance the bridge.

Nothing to it, is there?

Another way of balancing the bridge is to vary the ratio between R3 and R4 until it is the same as that between R1 and R2, and this is the method generally adopted in the bridges we have been discussing. When a battery is used as a source of voltage the indicator will be some kind of meter with a centre zero and called a galvanometer.

If, instead of the battery, we use an AC supply, some rather interesting possibilities are opened up. First, the indicating voltage may be amplified before being passed on to the indicator, which may now be one of the "magic eye" valves. This combination gives high sensitivity at low cost and with complete elimination of overload risk.

"C" AS WELL AS "R"

Secondly, the use of AC means that a pair of condensers or a pair of inductors may be substituted for the resistors R1 and R2, and their values compared just as readily, thereby making an extremely versatile instrument.

And that, very roughly, is what makes it tick.

There are quite a number of finer points to the design, quite naturally, but there is nothing especially tricky about making one, if you have a suitable circuit. If I ask the Technical Editor very nicely I'm sure he will reproduce a typical one with this article, and if you care to compare it with my sketches you should be able to follow how practical use is made of the idea.

As I hinted earlier, commercial units are also available. These are usually well designed and built, and a very nice instrument for those who can afford them or who have not the time to build their own. However, they will set you back about £40, in round figures.

This seems to justify the device mainly on the assumption that you can make it rather than buy it. Considering the relatively few parts and the simplicity of most circuits, you should be able to do this for a minimum of "man-hours" and with a considerable saving in cost.

Probably the biggest job is that of calibration, but this is not beyond the capabilities of the average serviceman and one or two known standards can, with a little ingenuity, be used as a basis for a large number of calibration points. If the various ranges are chosen with correct relationship (i.e., multiples of 10 or 100) the calibration of one range may serve for the remainder, while the resistance markings may also. be used to calibrate the capacitance markings.

SERVICE JOB

Which, I think, covers most of the major aspects of this type of instrument. While not the type of thing to dash out and buy first off, it can become a valuable edition to your equipment after you have settled down to the more essential types.

And now back to some service work.

One of the largest audio amplifiers I have handled for a long time came my way this month. Belonging to a large industrial organisation, it was used for a pageing and "music while you work" system extending throughout their offices and factory.

The output valves were a pair of 807's and apparently were intended to be operated somewhere near their maximum rating. This was indicated by an interstage push-pull transformer of a type intended for class AB2 work, as well as a 6V6 as a power driver preceding it. In addition, the power supply was a fairly elaborate affair with two rectifiers, one a heavy duty type, plus some very solid transformers and chokes. In the early stages of the amplifier there were two 6SJ7's, one as a voltage amplifier and the other as a microphone preamplifier.

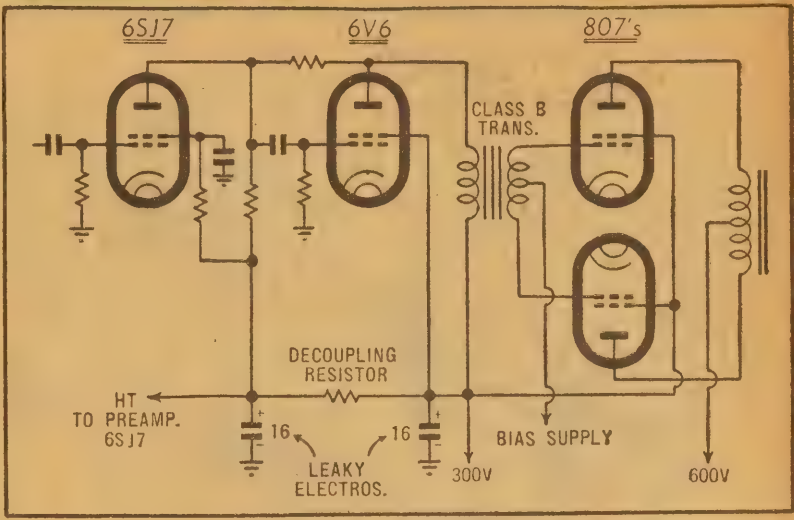
LOW OUTPUT

This rather impressive array should have been capable of an output in the order of 60 to 80 watts, depending on the operating voltages of the 807's, and also have plenty of sensitivity for pickup and microphone work.

According to the staff member who escorted me through the factory (it was not the type of installation one could conveniently tuck under one's arm and carry to the service shop) it had, in fact, ample reserve of both when first installed but, over the last few months, had gradually deteriorated until now it was necessary to advance the gain control to almost full on to obtain sufficient volume.

"But the worst part," said the staff member, who apparently had the

EFFECT OF CONDENSER FAILURE



Strange things happened to the voltages in this large amplifier when a block filter condenser developed a heavy leak.

job of operating the thing, "is the fuzziness that occurs whenever we strike a loud passage on the record. At first I thought the records were worn, but new ones are just the same."

To prove his point he proceeded to play a record, a new one, at the normal level required for the factory. On soft passages the reproduction was reasonable, although there was a suggestion of distortion which would probably pass unnoticed to all but the practised ear but, on loud passages, the distortion was quite intolerable, suggesting that the available power was much below that required.

My first step was to check the voltage on the 807's which proved to be very much wide of the expected figures. The plates showed just on 800 volts, while the screen had only 200. This did not exactly tie in with the normal operating conditions for this class of service, for which the maximum ratings are 600 to 300 volts respectively. I imagined that these conditions, or something approaching them, were the ones intended, and this was confirmed by an examination of the power supply.

SPECIAL SUPPLY

The power transformer had a tapped secondary, the outer terminals supplying 700 volts each side of the centre tap and feeding into a 5R4GY rectifier. The filter was a choke input type, as one would expect, and this should have delivered about 600 volts at the output. This part of the power supply fed the 807 plates only, the HT for the remainder of the set coming from the lower voltage tappings on the transformer.

These supplied 300 volts each side of the centre tap and, in conjunction with a 5V4 rectifier and conventional filter system, should have provided an output voltage of roughly the same order. This was the HT supply for the two 6SJ7's, the 6V6, and the screens of the 807's. A separate supply with a small metal rectifier provided the bias voltage for the 807's and this appeared to be functioning normally, delivering just under 30 volts.

It seemed fairly definite that the low voltage on the screens of the 807's was the basic cause of the bother, causing, in turn, low plate current and high plate voltage, with severely limited power output.

Working on this assumption I first checked the 5V4 rectifier, fortunately having a spare with me, but the voltage remained around the 200 mark.

Next I suspected the 6V6, or its associated circuitry, reasoning that excessive current, due perhaps to a faulty bias component, could be overloading the HT supply. The bias measured 10 volts, which appeared to be about correct considering the reduced plate and screen voltage, and would probably increase to 14 or 15 when normal operating conditions were restored. The 6V6 could hardly be drawing too much current.

SCREEN CURRENT?

Could one of the 807 screens be drawing excessive current?

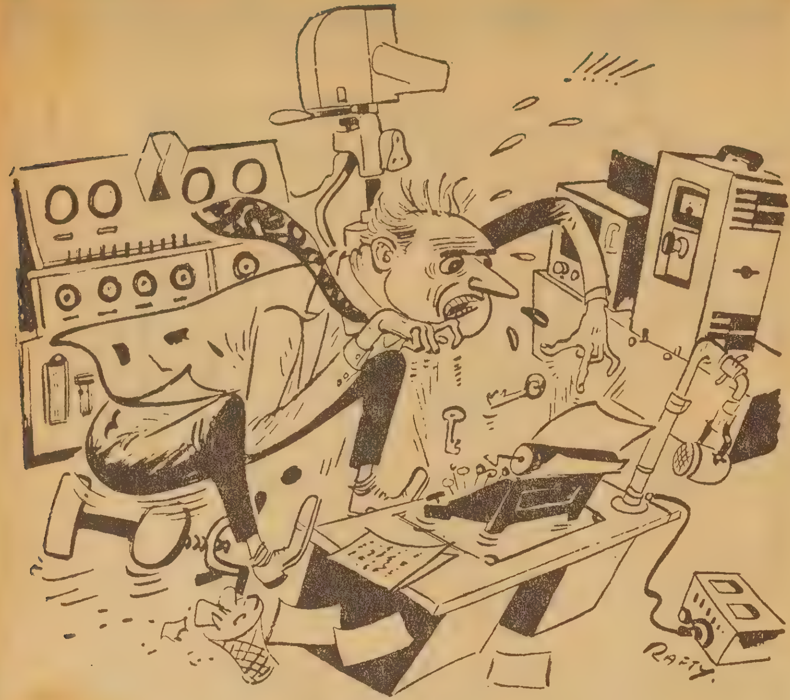
I checked this by the very simple method of withdrawing each 807, in turn, from its socket, while observing the screen voltage. There was no appreciable rise in either case, so I wrote that idea off.

This seemed to eliminate most of the possibilities in the amplifier, leaving the power supply as the only alternative. As I prepared to make a more comprehensive survey of the voltages at various points, my hand came up against the case of a 2 x 16 electrolytic block and I realised that it was warm, in fact, almost hot, and certainly at a much higher temperature than could be due to radiation from nearby components.

Closer examination showed that one section was the second filter condenser for the 300 volt supply. Removing it from circuit immediately restored the missing 100 volts and also reduced the 807 plate voltages to around 600. With a new condenser replacing the old one the performance was much improved.

But the operator still insisted that the sensitivity was down or, as he put it, "The volume control never needed to be turned up that far

(Continued on Page 106)



was a set of curves showing output impedance, power output and distortion as a function of the screen tapping position. The curves indicated that you could apparently have your cake and eat it, too.

With the screen tapped at about one-fifth (in terms of impedance) from the B-plus end of the load, a tetrode type valve would exhibit much the same output impedance and distortion as for the straight triode connection, but with the full efficiency and power output of the tetrode connection.

That means, in turn, that you can start off with what is inherently, and in every way, a very good output stage and proceed to make it a lot better by the application of feedback. You have the advantages of triodes and tetrodes completely sewn up in one parcel.

ANY CATCHES?

Having made a statement like that, you begin to look for the catches and, with all due respect to friends Hafler and Keroes, there may well be some. Their curves do not reveal the methods or conditions of test nor is it apparent whether measurements on the 6L6 would bear any close relationship to other tetrodes.

It may well be that some learned gent with a lab-full of meters and graph paper will utter the technical equivalent of the phrase . . . "Hey, but wait a minute . . ."

Let's Buy An Argument

We've thrashed pretty solidly of late the uncertainties of sound reproduction — record characteristics, pickup performance, speaker performance and room acoustics. We've pointed out, many times, that these things determine the final result far more than the minor differences between a "good," a "very good" and a "superb" amplifier. After all that, one would expect to be completely oblivious to the appeal of a new circuit.

by W. N. Williams

I MUST admit, perhaps shamefacedly, that such is not the case.

Looking through the current "mags." just before the last issue went to press I came across an article in Audio Engineering which described a rather new idea in connection with amplifier output stages. You probably noted a mention of it in the Technical Review section.

It was referred to there as the "Ultra Linear" amplifier but a name like that is just pure skite. Until someone thinks of a better name I'm going to refer to the circuit principle as "PARTIAL TRIODE" operation.

The authors (Hafler and Keroes) worked on a very simple hypothesis.

Power triodes, they noted, exhibited a low output impedance and low distortion at moderate volume—both very important characteristics.

By adding a screen grid to the valve and thus producing a tetrode structure, it was possible to gain higher output and plate efficiency but, unfortunately, both the low-level distortion and the output impedance suffered a reverse in the process.

With valves like the 807 and 6L6, either tetrode or triode operation is possible, according to whether the screen is connected to the B-plus or to the plate end of the output load. Perhaps an interesting compromise could be effected, they reasoned, by tapping the screen part-way along the load.

The result of their investigation, as we mentioned in the review,

For all that, I liked the idea and, transformer and "catches" notwithstanding, opined that it was worth following up—even to the construction of an amplifier.

With what utter scorn the editor reminded me that I would never hear the difference! Hadn't I said so myself? Hadn't I stood mutely by while he said likewise?

Sadly I had to admit having said and done these things—to admit that I still believed them. There was absolutely no point in following up the circuit! But I still think it's interesting.

Mention, earlier, of the uncertainties of domestic sound reproduction leads me to another train of thought which might seem, on the surface, to be ever so naive. Yet I wonder how many of the folk who concentrate so heavily on circuits have really sat down and given such things due consideration.

I refer to those many factors which so vitally modify the emanations

from the loudspeaker — before we ultimately hear them as sound.

The things I have in mind are difficult to analyse on a quantitative basis, yet they're likely to affect the final result quite a lot. Don't expect me, therefore, to say, "You must do precisely this" or "you must do precisely that." I only wish that the answer could be in such terms but it isn't.

Still, no harm will be done by speaking in generalities.

One of the things I have in mind is the distribution of high frequencies from a loudspeaker. We are likely to say, quite blandly, that the highest frequencies are projected in the form of a beam and, to hear them, the listener must be located in front and on the axis of the unit. Is the statement complete?

We've probably all seen speaker response curves taken in free space or in acoustically dead rooms, which indicate the areas in which good top response may or may not be expected. Some speakers, notably those with specially designed high frequency cones or horns, show better distribution than others, as is only to be expected.

IN THE HOME

While such curves are quite important in the professional sphere, they lose a good deal of point when the equipment is operating in the average living room, which is anything but acoustically inert. Numerous reflections occur to modify considerably the "beam-of-sound" idea.

In case you doubt the veracity of this statement, arrange if you can to feed your amplifier with a clean, sustained signal up around the 9 to 10 Kc. mark and see whether you can lose the sound. Close your eyes and move quietly round the room—see how the sound seems to follow you, even into the most unlikely spots.

Then stand still in a few places, close your eyes again and slowly move the head round and about. You'll most likely notice the sound varying in strength and you may even pick positions where it is largely lost.

I know full well that you don't listen to that kind of sound in everyday experience, but it's important to realise that music is made up from an infinite number of "little bits" of sine wave and they are all subject to the same kind of reflection, reinforcement and cancellation as you hear with a sustained tone.

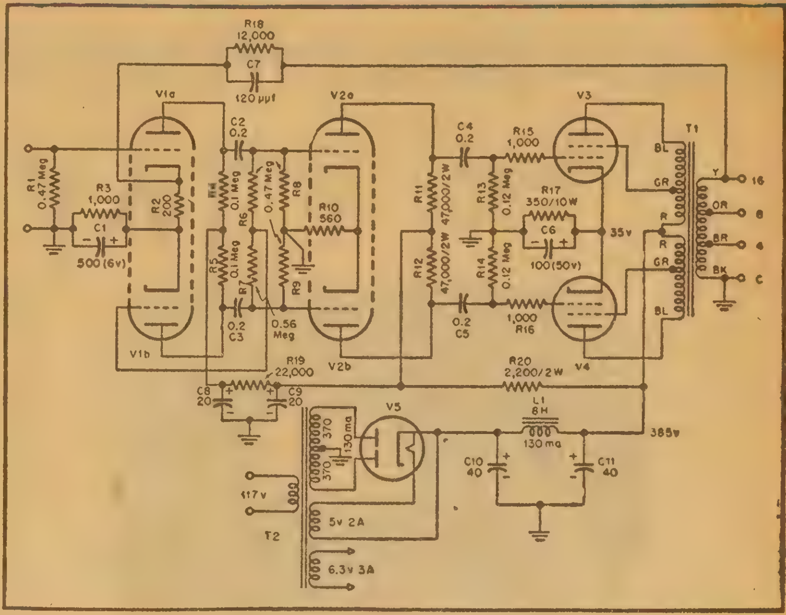
In other words, the sound you hear isn't only what comes from the loudspeaker. It's that—plus the energy which bounces back at you from walls, windows and furnishings.

WHAT TO DO

The answer might seem obvious. You simply fill the room with drapes and carpeting to kill the reflections, put the speaker in one corner and sit across the room directly in its beam. You may now hear only the direct sound, but I doubt whether you will altogether like the effect.

I remember, some time ago, listening to a demonstration of some very ambitious equipment installed in an acoustically very - dead recording studio. The quality of the sound, in terms of frequency range and distortion level, was beyond reproach, but I have never before been so pain-

"PARTIAL TRIODE" OPERATION



We've christened this circuit idea "Partial Triode" operation. Curves supporting the author's claims are shown below.

fully aware that every vestige of the sound was squirting out through a tiny hole in the wall.

As far as I was concerned, the "hole-in-the-wall" effect largely nullified the virtues of the system in other directions.

So then, instead of taking steps to prevent all reflections in the listening room, we are more likely to desire them in moderations to help camouflage the point source of sound. It is a matter of pure compromise how much of each effect we are able individually to arrange or to tolerate.

TWO-WAY SYSTEM

If we had access to a stereoscopic system of recording and playback, a more rigid approach would be possible, but, until that comes about, we must do the best with what we have. Perhaps it isn't too bad, after all!

Before saying any more about the high frequency end, let's consider what happens in the middle and lower registers. It is erroneous to consider the speaker as a device which feeds level and high quality sound into a completely inert and disinterested space.

On the contrary, the ordinary listening room has very tangible dimensions and characteristics and is an active participant in the building up of sound pressures.

In the recent discussion on loudspeaker cone resonance, we quoted the findings of one well-known writer, J. Moir, that the average listening room exhibited some half-dozen distinct modes of resonance in the lower register, each one exhibiting a comparatively high "Q" factor.

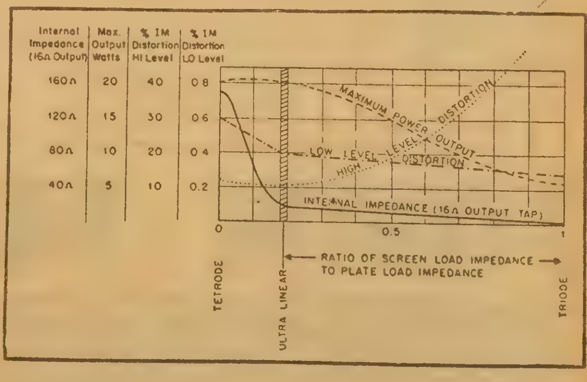
The worst type of room, in this respect, is one approximating a small "live" cube, where the modes of oscillation due to its three major dimensions all occur in the same region of the octave.

It has been suggested that the ideal room proportions are in the ratios of 1; 2 1-3; 2 2-3, these being most likely to distribute the major resonance effects and give a fairly even room transmission response.

It has been calculated that, to reproduce an organ pedal note of 28 cps and have it within the range where the room gives gain rather

☆

These curves indicate, for the 6L6, the transition from tetrode to triode operation. In the shaded zone virtually the outstanding advantages of both are obtained.



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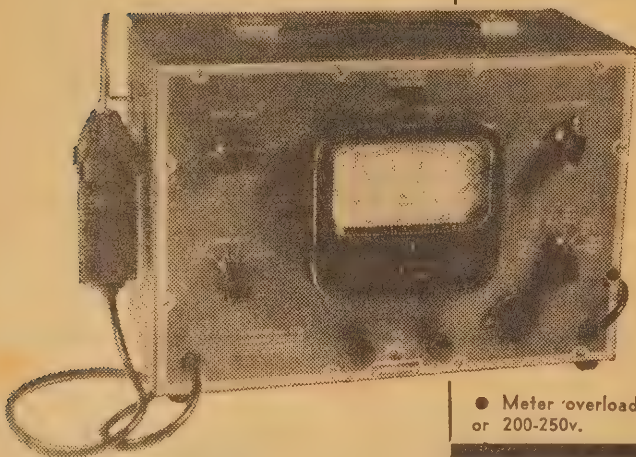

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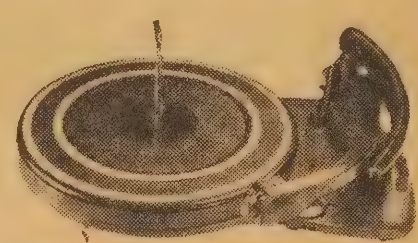

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than attenuation, one dimension must be at least 20 feet.

A further point is that, in order to excite the foregoing room dimensions in all possible modes, thereby achieving more even spacial response, the speaker must be located close to a corner, either at floor or ceiling level.

What kind of a result emerges then, when these acoustic requirements are merged with those for a room that you'd want to live in, anyway?

It might add up to an argument, or to an exchange of ideas, or to nothing at all!

In the first place, I suggest, the listening room must be quiet and restful, otherwise you never will be able to relax and appreciate the softer passages. Doors and windows must therefore provide reasonable insulation against noise from the street, the kitchen and the nursery. (The latter provision, of course, works both ways.)

Then, unless somebody has dropped a decimal place, one dimension of the room must be at least 20ft, to permit the development of adequate low frequency energy. The matter of optimum proportions can also be thrown in for good measure but, whether or not your room comes within cooee of these figures, is a matter, I imagine, of good or bad fortune.

Most of us have to make do with the room—and therefore the low frequency propogation characteristics—which strictly non-acoustial circumstances have imposed upon us.

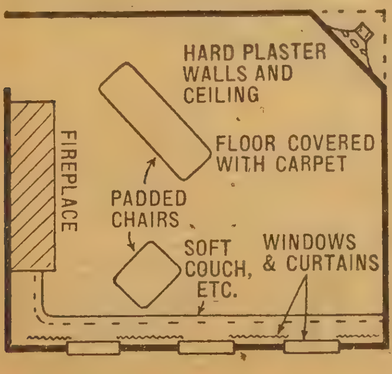
What goes on at the top end is, fortunately, amenable to more control.

The technique which seems to be gaining favor (and I am merely borrowing the term) is that of "live-end-dead-end treatment." This is borrowed in turn from studio practice.

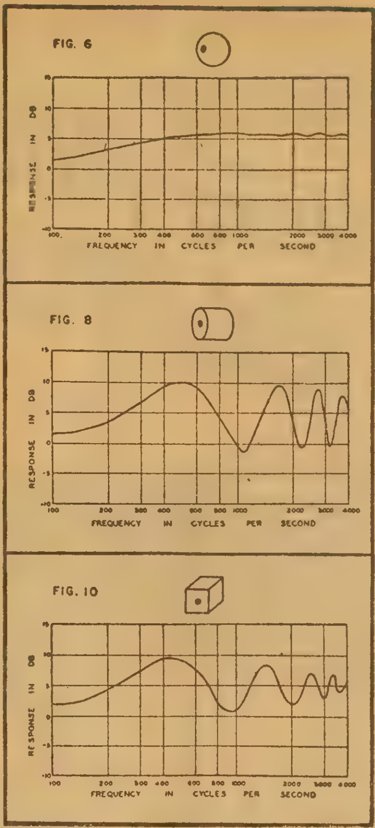
Applied to your listening room, it means that the speaker is placed at the far end of the room and surrounded, in its immediate vicinity, with relatively hard walls and reflecting surfaces.

You, the listener, and your audience, are at the other end of the room, comfortably seated in padded chairs, deep pile rug beneath your feet and heavy curtains across the window by your side. The fireplace, logically, is at the same end of the room.

The principle is not hard to follow.



The suggested layout for a live-corner-dead-corner listening room. Two walls are hard-surfaced, the other two acoustically deadened.



Three of twelve curves published recently by H. F. Olson, showing the effect of mounting a speaker in a spherical, a drum-shaped and a cubical enclosure.

You still hear the treble "beamed" directly from the speaker but along with it comes the sound reflected from the "live" surfaces at the same end of the room. You can pick the source of sound, if you want to concentrate on a voice, but there is enough dispersion to give some illusion of breadth.

The important point is, however, that the reflections are arriving, for the most part, from the same general direction as the speaker. Those which might otherwise bounce from your immediate surroundings are prevented by the aforementioned carpets and curtains.

And your feet don't scrape on the floor, either, every time you move!

How much "live end" and how much "dead end?" I guess that's up to you but you may like to start pushing things around.

Beyond this, many of us might have to call a halt—simply arrange the furnishings as aforesaid, stand the enclosure across the far corner and leave the matter rest.

You might, as a variant, however, dream up an enclosure which causes the speaker to spill its highs obliquely upwards against a hard wall or a corner. You now hear only the reflected highs but, believe me, they can sound very convincing.

For those who can take structural liberties, the whole technique can be carried further and to better effect.

One scheme, featured recently, places the speaker on a baffle, filling the corner made by two walls and the ceiling. These are virtually unbroken plaster surfaces and constitute something of a low frequency horn, as well as a means of dispersal for the highs.

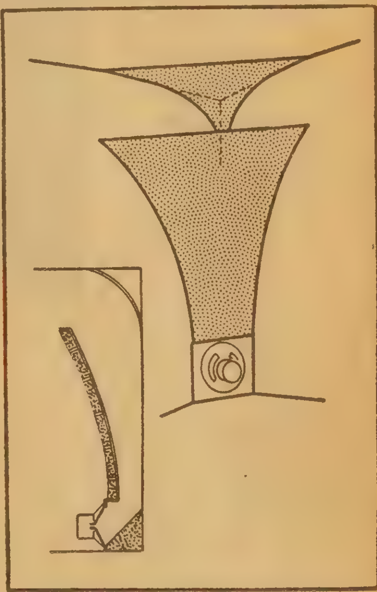
The rear wave is trapped away into the domestic garage or some other innocuous space. Meanwhile, the remaining walls are broken up with curtains, padded benches, &c, and the whole floor covered with deep carpeting.

The treatment was described as "live - corner - dead - corner" — for very obvious reasons.

Then there is the technique of turning the whole corner of the room into a virtual horn, so that the walls and ceiling take over where the frame of the horn leaves off. There are many possible variations to this scheme but most of them involve a major job of installation and redecoration.

Then, lest you tend to discard all that as simple "sissy" stuff, let me mention a paper published recently in Audio Engineering, by Harry F. Olson.

He points out that the radiation from a speaker is affected principally (1) by the design of the speaker it-



A possible scheme for a corner horn. Highs are reflected from a hard block in the corner. Apparent weakness of the scheme is the lack of control over back radiation from the cone.

self, (2) by the rear cone loading provided by the baffle, and (3) by the frontal contours of the baffle, which control sound diffraction effects.

While most of us have chewed our fingers about (1) and (2), number (3) has been almost completely neglected. But you really shouldn't neglect it when you're at the stage of worrying about a few db. plus or minus.

Olson's curves, which were taken on a scaled down basis, would give you the green willies if they applied to your pet amplifier.

Once again, they are for an acoustically dead chamber and they may

(Continued on Page 110)

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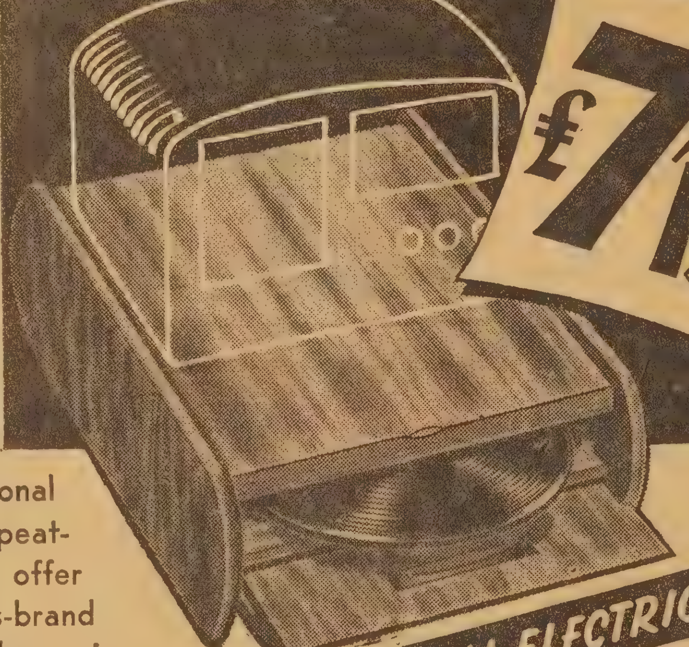

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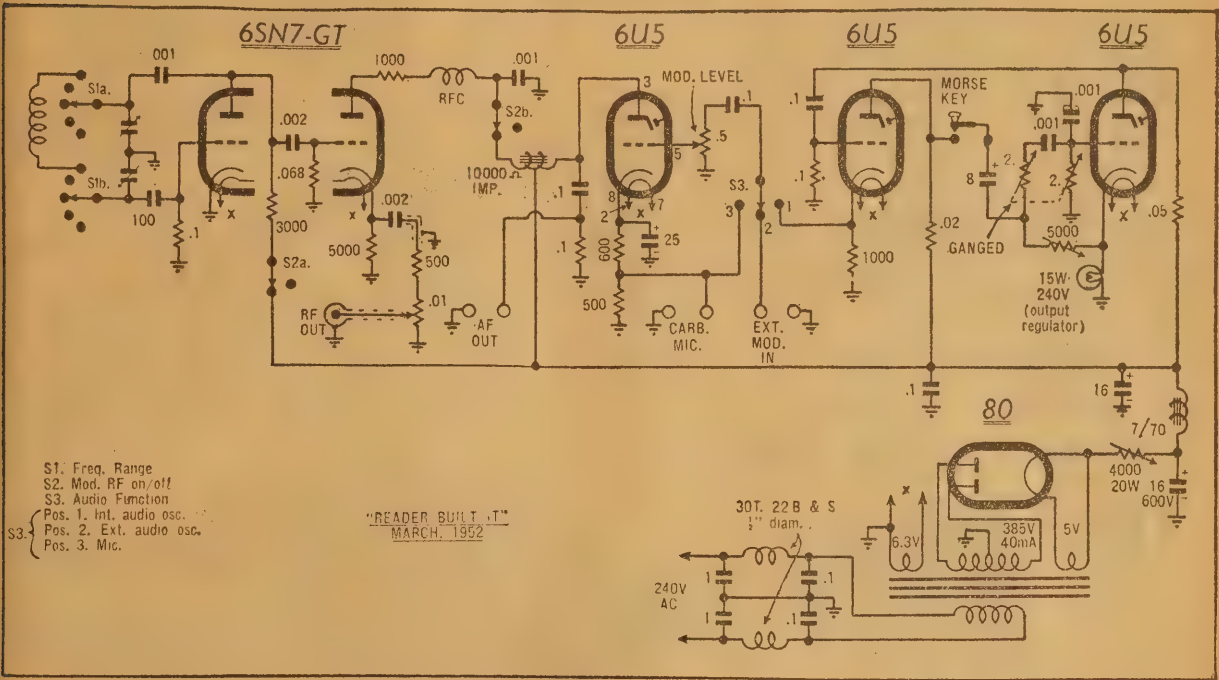
SERVICE OSCILLATOR HAS INTERESTING FEATURES



Prompted by discussion some months ago on service oscillators and signal generators, a Queensland reader submitted the circuit details presented here of a 5-band job. Some of the features incorporated may prove of interest to other readers.

OUR contributor is Mr. B. M. Byrne, of St. Leo's University, Wickham Terrace, B.17, Brisbane.

The liberal use of the 6U5 may seem odd, because it is essentially an electron ray tuning indicator for receivers. Apparently, Mr. Byrne had a number on hand and decided that the triode section could be put to some use. Ordinary general-purpose triodes could be substituted.

The RF section is built around the two triode sections of a 6SN7-GT, one section being wired as a Colpitts oscillator and the other as a buffer output stage. This output stage reduces frequency variation resulting from modulation and provides a low impedance output for the RF.

The coil data can be the same as for the All-Band Service Oscillator described in the May, 1947, issue, provided that you use a 2-section tuning gang of around 400 pf maximum capacitance.

The output attenuator control should be of the carbon type rather than the frequency-conscious wire-wound type. Our contributor says that the attenuator provides a range of output from about 0.5 microvolts to 4 volts below 10 mc. Above 10 mc there is some variation from these figures.

The audio side of the instrument consists of two triodes wired in a type of Weighbridge oscillator and feeding into another triode which modulates the RF section. The audio oscillator has a frequency range of 50 cycles to 22 kc in one sweep of the ganged 2 megohm potentiometers.

As Mr. Byrne points out, the ganged potentiometers are the main practical difficulty. They are not easy to obtain and it is a problem attempting to align mechanically two single potentiometers to do the job.

The morse key allows the audio oscillator section to be used for morse practice if desired.

The modulator works into a centre-tapped choke used as a modulation transformer. The primary winding of a 10,000 ohm centre-tapped speaker transformer would do nicely.

The switching arrangements is open to variation. The frequency range and RF on/off switching is obvious. In the audio section, provision is made for the internal oscillator to be used for modulation or morse practice, for external modulation to be fed to the modulation valve and for the modulation stage to be used as a preamplifier for a carbon microphone to drive an external audio system.

OTHER TRANSFORMERS

Although a 385 volt-per-side transformer is shown in the power supply, any size down to around the 225-volt-pas-side mark would be practicable. The 4000 ohm resistor at the rectifier disposes of excess voltage and would normally be adjusted to set the output voltage from the filter to around 250 volts.

The transformer primary winding is decoupled from the mains to minimise leakage of the RF signal.

As a matter of interest, there is a pamphlet entitled Calibrating a Service Oscillator available through the Query Service for a nominal charge. The details also appeared in the July, 1947, issue of Radio and Hobbies.

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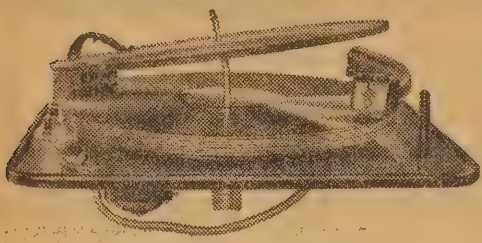

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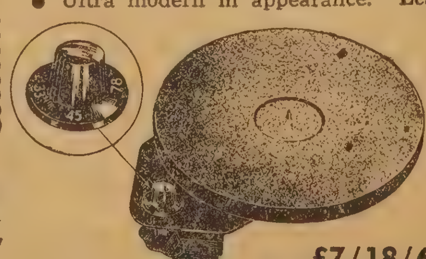

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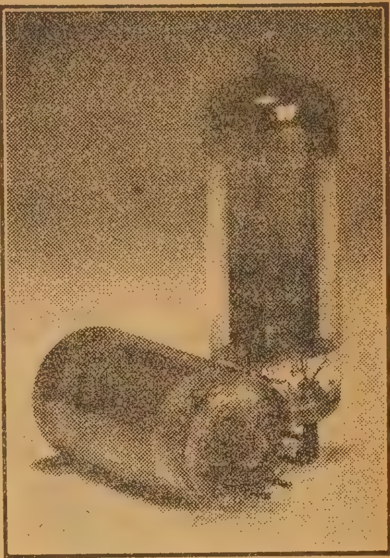
TRADE REVIEWS AND RELEASES

STC RELEASE NEW BRIMAR MINIATURE VALVES

The present trend to the adoption of miniature valves lends special interest to the latest release from Standard Telephones and Cables Ltd. They are now able to deliver from stock the 6BW6, a miniature beam power tetrode, and the 12AH8, a triode-heptode frequency changer.



THE 6BW6 is actually a miniature version of the well known 6V6-GT, being fitted with a Noval (9-pin) base and having overall dimensions of 2-5/8 x 7/8in.

Despite the reduction in size, it carries the full voltage and wattage ratings of the larger tube. Thus, the plate rating is 315 volts, 12 watts, while the screen rating is 285 volts, 2 watts. The heater draws 0.45 amp. at 6.3 volts and has a heater-cathode potential rating of 250 volts.

These figures, considered alongside the all-glass construction and short internal leads, would make the tube seem very attractive for moderate power transmitting applications, possibly to around the 100 Mc. regions. This would be in addition, of course, to its normal application in receivers and amplifiers.

Of special interest, too, is the Class AB2 rating for the 6BW6 and/or 6V6-GT, which credits them with a power output of 30-watts. The figures are as follows:

Plate voltage, 315 volts; Screen voltage, 285 volts; Grid voltage, -19 volts; Peak AF volts G-G, 80 volts; Plate curr. Zero Sig., 70mA.; Plate curr. Max. Sig., 155 mA.; Screen curr. Zero Sig., 4 mA.; Screen curr. Max. Sig., 16 mA.; Peak input power, 400 mW.; Output load P-P, 5000 ohms; Total Harm. Dist., 7 pc; Power Output, 30 watts.

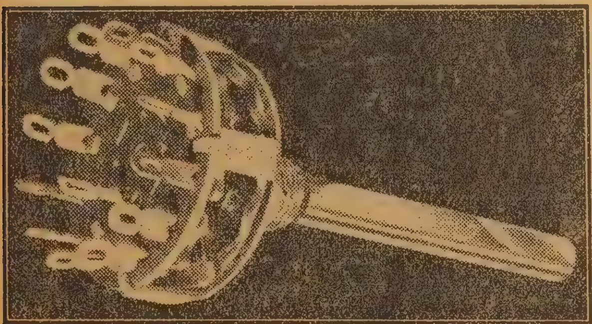
As is normal for class AB2 operation, the valves require a well regulated plate and screen supply, fixed bias and low impedance drive through a low-ratio transformer.

The 12AH8 triode-heptode frequency changer is also on a noval base but it has a universal 6.3/12.6 volt heater. Designed to give high conversion gain, it has a conversion transconductance of 0.55 mA./Volt and an output plate impedance of 1.5 megohm. The triode section has a nominal transconductance of 3.5 mA./V and an amplification factor of 17.

Messrs. Standard Telephones and Cables have assured supplies of these and other Brimar miniature types. The valves are available through normal trade channels.

"JABEL" ROTARY WAFER SWITCH

Meeting the current shortage of wafer switches, Messrs. Watkin Wynne announce the release of a new "Jabel" single-bank, rotary switch, which will be available with variety of switch contact arrangements.



FOLLOWING a familiar type of construction, the switch has an overall maximum diameter of 1½in and is approximately 1in long from the mounting boss to the tip of the contacts. Shaft length in the switch shown is 1¾in.

All contacts in the switch are of phosphor-bronze, silver plated. The contacts are twisted through about 30-degrees after assembly, to prevent any tendency to looseness. The assembly plate is of high-grade bakelite and the clicker mechanism of nickel-silver.

Supplies of the switch will be available through trade houses, the price varying according to the contact arrangements. The sample shown in the photograph is a three-position, four-pole type, suitable for small dual-wave receivers.

Messrs Watkin Wynne also announce the release of a modified Jabel "Junior" trimmer, having a standard capacitance range of from 4-40 pf.

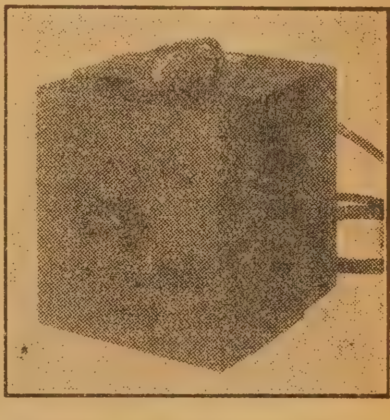
Feature of the new trimmer is the use of an urea moulding for the body section, which resists malformation due to heat when soldering. The trimmer can be supplied for bulk orders only with a specially reduced low-capacitance range.

The standard trimmers, padders and terminals are supplied still with trolitul moulding.

(Jabel products are available through Trade houses. Trade enquiries only to the factory representative, Watkin Wynne Pty. Ltd., 173 Pacific Highway, North Sydney, NSW.)

NEW FERGUSON TRANSFORMER

Latest release from Ferguson Transformers Pty. Ltd., is a heavy duty step-down unit to 110 V. AC. Designated as type PF 381, the new transformer has a continuous load rating of 1 KVA. It has an adequate safety factor to take care of



accidental overload beyond this figure.

Intended especially for use with projectors and other like equipment, the transformer is assembled with metal shell ends and fitted with a carrying handle. A 3-way cord plugs into the 240 V. outlet, while a standard 2-pin flat plug provides the 110-volt connection.

Retail price for the PF381, which includes the sales tax, is £27/19/-. (Ferguson Transformers Pty. Ltd., Ferguson Lane, Chatswood, NSW.)

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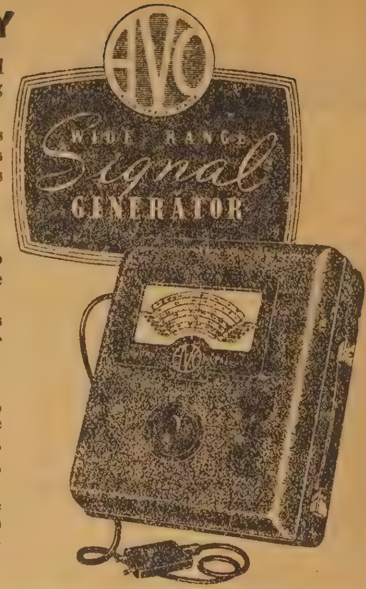
500 Kc/s	1.5 Mc/s	20 Mc/s	80 Mc/s



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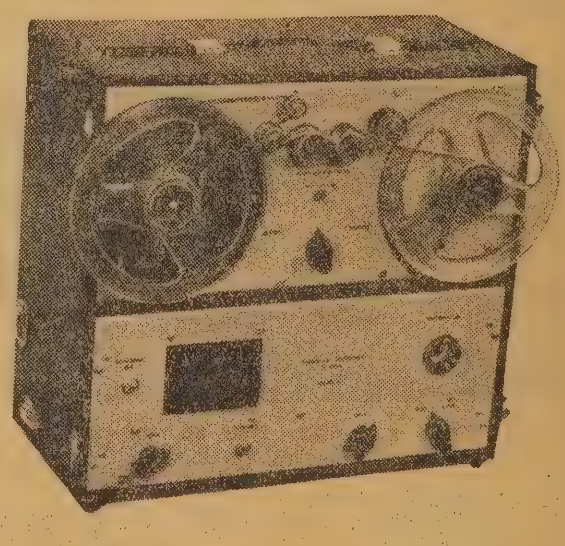

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ADDITIONS TO "INNOVAL" RANGE

Philips Electrical Industries announce the addition of three new valve types to the Innoval range of valves for A.M. broadcast receivers. These comprise a duo diode R.F. Pentode; an indirectly heated Rectifier and a Remote cut-off R.F. Pentode.

TWO of these types are already available and the third will be released in the very near future.

Type 6AD8 is a duo - diode medium cut-off pentode primarily intended for use as a combined I.F. Amplifier, Detector and Reflexed A.F. Amplifier in four valve receivers. It is equally suitable for all R.F., I.F. and A.F Applications calling for a valve having a lower mutual conductance (1100 umhos) than that of the Innoval type 6N8 (2200 umhos). Retail price is £1/-/9.

Type 6V4 is an indirectly-heated full wave rectifier. Its maximum ratings (condenser input to filter) of 350 volts R.M.S. per plate, an output current of 90 mA D.C. and permissible heater to cathode voltage of 500 volts peak, assure adequate output voltage and current for all small receivers and amplifiers. Retail price is 15/3.

In the design of the 6BH5, which is intended for the R.F. and I.F. stages of standard A.M. receivers, due account has been taken of the accepted commercial standards for associated components used in Australian receivers and its electrical characteristics have been chosen accordingly.

The mutual conductance of 2200 umhos with a cut-off bias of—39 volts, a grid to plate inter-electrode capacitance of 0.002/uuF maximum and a plate resistance of 1.0 megohm will be found to give stable results without imposing difficulties in regard to choice of associated components. Available during March/April, retail price will be 19/-.

Types 6AD8 and 6BH5 include special internal shielding to provide low inter-electrode capacitances and obviate the need for an external shield can.

PLESSEY REP. ON TOUR

COMBINING business with convalescence from a serious illness which overtook him early in 1951, H. T. Parker, of The Plessey Group of Companies, England, arrives in Sydney on March 24, aboard R. M. S. Oronsay. En route, he hopes to visit Perth, Adelaide and Melbourne during the ship's calls at those cities, and will probably return at a later stage in his tour. During the first half of April he will be visiting New Zealand, and will return to Sydney before the end of the Royal Show.

He joined Plessey five years ago to form their Sales Promotion Department, and was promoted general manager, Marketing Division, 18 months ago. Plessey, with over 10,000 employees, are now one of the largest electronic and aeronautical accessory groups in Britain, manufacturing a large range of engineering products.

"BRAMCO" MIDGET, STANDARD COILS

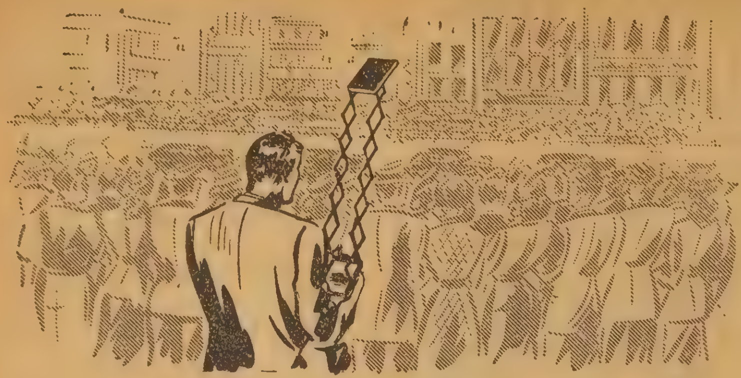
INTENDED for small portable and auto receivers, Bramco are now offering a complete range of midget coils and IF transformers. The various types, for AC and battery valves are distinguished by a code.

The coils are housed in standard ¾in square cans, having a seated height of 1½in. The IF transformers are in somewhat taller cans.

In addition to these midget components, Bramco are now marketing coils and IF transformers in the larger 1 3/8in square cans. These are available in "standard" and "high gain" types and oscillator coils are available to suit representative converter valves.

Included in the range, also, is a midget coil bracket for 4-5 valve receivers covering the broadcast band and the 16-50 metre short-wave range.

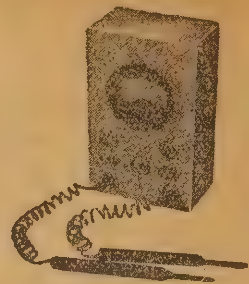
"Bramco" products are carried by most trade houses. Factory representativees for technical and trade inquiries are Messr. Phillips Agencies, 27 Hunter St., Sydney.



PERISCOPES

These Periscopes are ideal for unobstructed vision in large crowds. Sturdily constructed, consists of 2 mirrors 4½" x 3¾" with collapsible metal frames, and will extend to 30" overall. Complete with canvas case.

Price only 12/6.



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PAILLARD AUTOMATIC RECORD CHANGER

Immediate Delivery

Variable speed, plays 8-10 inch or 8-12 inch records.
High quality lightweight head. Finished in Fawn, crackle enamel and Chrome. Brand new and boxed.

Our price while they last 19 gns.

Also Genuine English 3 Speed Plessey

Will automatically play a mixture of 8 inch, 10 inch and 12 inch records either at 78 r.p.m. for standard records or at 33 r.p.m. for microgroove and also automatically play 7 inch 45 r.p.m microgroove records. Has turnover crystal head. The very latest changer on the market. Brand new and boxed.

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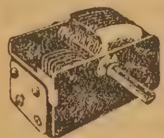
MAGNETS

These powerful magnets are ideal for youngsters and make and ideal gift. They measure 2" x 3" x 3-8" and are rounded on the corners.

Price only 2/6 each.



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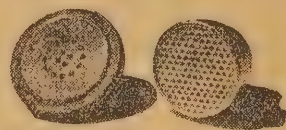

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Brand New 2/6

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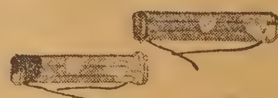

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Prices as follows:—

50 assorted	15/-
100 assorted	27/6
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SHEFTI MOVING COIL PICK-UP

Made in England this is a really high quality job capable of giving good reproduction of all audio frequencies.

Very lightweight head will prolong life of your records.

Each Pick-up complete with boosting transformer.

Brand new and Boxed.

Extra Special value at 39/6.

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PREPARING FOR WINTER BLACKOUTS

Blackouts, it seems, are like the poor—destined to be always with us. Perhaps this is being unduly pessimistic, but it does appear that in the coming winter we will be plagued with the usual crop of power interruptions. With this thought in mind a few words on emergency lighting systems may be timely.

A SYSTEM which is extremely popular for the home, small shop, doctor's surgery, &c, is a 6 or 12 volt battery operating two or three lights in the most strategic places, and kept topped up with a small charger connected to the mains.

On the face of it such a system appears extremely simple and it may be thought that there are few points to be discussed. Actually there are quite a number of pitfalls, a fact which is emphasised by the number of such installations which give extremely poor light. Many imagine that such results are inevitable and that nothing better should be expected from what is, after all, only an emergency system.

On the other hand, a certain financial outlay is involved and one may just as well have the best possible results for that outlay, particularly if all that is required is a little forethought and perhaps a few shillings extra on minor components.

Which brings us to the natural question of just how good a light one may expect from such a system. Globes for 6 and 12 volt operation are available in the same physical size and with the same bayonet cap as the standard 240 volt types, and in ratings from 15 to 60 watts. An excellent size for ordinary room lighting is 40 watts and, if you are tempted to compare this unfavorably with the 60 or 75 watts you normally use, let me hasten to assure you that all 40 of the watts will be working overtime.

HIGHER TEMPERATURE

Due to the extremely small area of the filament there is considerablly less loss of heat due to radiation, and a given power will raise the filament to a higher temperature than in higher voltage types.

This means a greater efficiency, so much so that a 40 watt globe will give at least as much light as an ordinary 60 watt, although the general impression is that it is actually more. This is supported by readings made with a foot-candle meter, although there is some possibility of error due to the different colour of the light, again due to the higher filament temperature.

The difference is even more marked when a blackout actually occurs, since the line voltage is generally very much reduced immediately prior to it (i.e., more so than usual.) and a 40 watt globe will more than hold its own.

All this is assuming that the emergency globe has something like its rated voltage applied, and this is where most systems fail badly.

A 40 watt, 6 volt lamp will pass approximately 7 amps and, at this current flow, it requires only a fraction of an ohm resistance in the circuit to introduce troublesome voltage losses. Thus the whole secret of success in such a project is eliminate all possible sources of such resistance and a little care will pay worthwhile dividends in the form of consistently good performance.

Perhaps the best way to cover all the essential points is to describe a typical domestic installation — the writer's own — which is now approaching its third winter and has been completely trouble free since first installed. Two rooms are wired, kitchen and breakfast room, these being undoubtedly the most vital spots when a blackout occurs (as it always does) in the middle of preparing the evening meal.

WIRING SYSTEM

These two rooms are adjacent to the back veranda, and it was found most convenient to locate the battery and charger here, using a small but substantial shelf about 3ft from the floor. This shelf not only makes the battery easier to look after, but also saves about 12ft of wire on the two runs, cutting down both cost and resistance losses. After due consideration it was decided to use a 6-volt system as the length of the run was not sufficient to justify a higher voltage.

In many cases it may be possible to locate the battery in an even better position, remembering that it should be as central as possible relative to the light positions, while a high shelf or the top of a cupboard will save a few more feet of wire.

It is very desirable to provide completely separate conductors for each run, as any attempt to use a common conductor will introduce serious losses, as well as causing a variation in voltage when other lamps are switched on. The wire used is heavy, about 12 gauge and is double cotton covered.

This is not the best insulation but, as it was obtained cheaply through disposals, it was considered worthwhile to take a little extra trouble to protect it with additional sleeving at vital points.

Alternative types of wire are the automotive cables. These are normally available with rubber insulation, cotton braided and lacquered, or in PVC plastic. The rubber types are normally classified in millimeter (mm) sizes and those of most interest for this work are 4mm (14 B & S or 16 SWG), 4.5 mm (12 B & S or 14 SWG), and 5 mm (10 B & S or 12 SWG). This last size is most suitable for 6-volt circuits.

The PVC plastic types are classified simply according to the wire gauge and are available in 10.12, and 14 B & S sizes as well as a 16 B & S (17.5 SWG) twin flat. This last one is most suitable for short runs in 12-volt systems or longer runs for very low wattage lamps. One advantage of the PVC type is that the insulation is thinner, often making possible a neater installation or easier fitting of lamp sockets &c.

The wires are taken through ventilators into each room and run across the ceiling to a point near the regular light fitting. The wire is then bent over to form a drop so that the new light is at the same level and immediately alongside the old one. A standard "chinaman's hat" reflector completes this part of the installation.

SWITCH POSITION

Where the wires enter the room one is formed into a short loop (about three feet) which is taken down the wall to the switch position. This position should be chosen mainly with regard to the length of wire involved, the normally most convenient spot probably involving much too long a run. However, this can hardly be regarded as a serious inconvenience.

The switches are good quality, 10 amp tumbler variety, and these have given excellent service, a recent check with a voltmeter showing only about .01 volt drop across them.

Quite apart from the quality of the units themselves, two precautions were taken when they were first installed. First the wires were soldered into the bushings, it being almost impossible to obtain satisfactory contact for this kind of service with the normal set screw arrangement.

Secondly, the riveted connections between the bushings and the spring contacts were also soldered, experience showing that this is prolific source of trouble even at lower ratings. Some care will be necessary with this job to avoid heating the springs and drawing the temper, but it can be done if the joint is cooled immediately with methylated spirit.

The provision of low resistance connections by soldering not only ensures minimum losses, but also protects the switch which, otherwise, would be heated by the resistance losses, causing loss of temper in the spring contacts, followed by still greater losses and still more heat until the switch is completely wrecked.

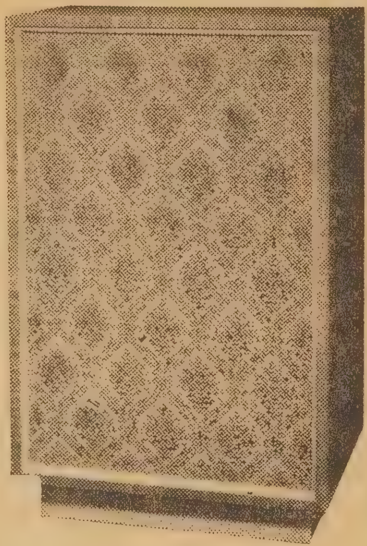
LAMP SOCKETS

The same remarks apply to the bayonet sockets which, although only rated to carry 5 amps, have given perfectly satisfactory service due to the soldered connections and elimination of heating. When selecting these, it is as well to keep in mind the size of wire to be accommodated, and sockets which will take the wire straight into the bush without having to bend it at right angles are to preferred.

The longer run of the two is approximately 20ft, involving 40ft of wire, and the voltage at the globe is 5.6 volts when the battery is exactly 6 volts. Most of this .4 volt loss is due to the wire resistance, only very small amounts being measurable across the various connections in the system. It is probable that these globes have been designed on the basis of some voltage loss in every

A High Fidelity Bass Reflex Loudspeaker

MODEL VE50 PRICE £45/17/3

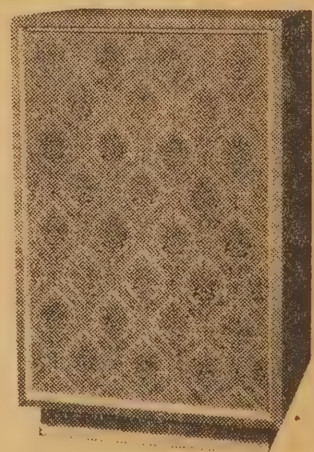


This unit comprises a selected Goodmans Axiom 150 loudspeaker mounted in a bass reflex cabinet (vented enclosure). Each unit is individually adjusted for resonance. The cabinet is supplied unpolished for matching your existing furniture.

Only supplied complete with loudspeaker and connecting plugs ready for use.

Dimensions: Height 39", Width 25", Depth 17½".

MODEL VE7 PRICE £22/12/9



Similar to Model VE50, only less loudspeaker. This unit is a bass reflex cabinet designed for 12" loudspeakers having a fundamental free air cone resonance between 50 and 60 cycles.

Unpolished cabinet only.

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system for they still give an excellent light at this voltage, but it would seem unwise to go below this figure if the best results are desired.

If at all possible, use pearl globes in preference to the clear variety as the latter can cause considerable eye strain. This is due to the extremely high intensity of light from the small filament area, an intensity which is much greater than is good for the eyes. The pearl globe overcomes this problem and does not, as is popularly supposed, cause any appreciable decrease in light output, the loss amounting to only 2 pc.

VOLTAGE?

A matter to be decided before going ahead with an installation is whether it should be 6 or 12 volts. Where the runs are limited to 30ft or so the 6-volt system would seem to be the best choice, provided all the precautions already mentioned are taken. The advantages are a considerable saving in first cost of the battery and, in many cases, some simplification of the charger. Against this, the wire may cost more and more care is needed in the installation, but this is hardly sufficient to offset the saving.

The writer uses a charger made from a disposals rectifier and a discarded power transformer which still has the filament windings intact. By connecting the 5 and 6 volt windings in series it provides the 11 volts needed to charge a 6 volt battery. The rectifier is a copper-oxide type intended to operate on either 12 or 6 volts at one amp.

This charging rate has proved more than adequate and half of this would probably still be satisfactory, since there are usually many days available for charging before another bout of blackouts occurs. An 11-plate battery will store sufficient power for several blackouts.

If long runs are unavoidable, the 12-volt system will undoubtedly be the better proposition, the higher battery cost being the price one has to pay in such circumstances. It will probably not be quite so easy to improvise a charger from existing gear since most rectifiers will require between 17 and 22 volts AC, and a transformer designed for this work will be necessary.

While an installation of this standard is very nice in the home, and almost essential in a shop &c., there are many cases where something less elaborate is sufficient. This is usually a domestic set-up, where it is intended to make use of as much equipment already "on hand" as possible, but where the ultimate in lighting is not considered necessary.

ANOTHER CASE

Typical of such an installation is that of a friend, who was faced with various circumstances different from my own. In the first place he decided to make use of a battery which had seen better days in his own car. Although of no further use in this application, he considered it still had enough life for light duties (no pun intended) and decided more or less to cut his coat according to his cloth.

To this end he decided to settle for a single light which was not a serious inconvenience, since he possessed a combined kitchen and dining alcove. As I mentioned earlier, it is the preparation of food (and the eating of it) which is most generally disorganised by a blackout and, if comfortable lighting is available in the kitchen, the job of getting light and heat elsewhere is greatly simplified.

Actually there is still sufficient light reaching the adjacent rooms to enable free movement without, as my friend puts it, tripping over the piano or measuring one's length on the dining room table.

There were certain objections to the use of heavy gauge wire, mainly that of making a neat installation without a major operation on the room itself. For this reason, together with the limited capacity of the battery, it was decided to settle for a medium wattage globe. The one finally selected was a 20 watt car "stop" light globe and this, even if slightly under rated, still gives quite enough light to carry on in comfort.

PLASTIC FLEX

The wire used was ordinary white twin plastic flex which matched the surroundings and permitted an inconspicuous installation. Although some losses are introduced in this way they are not serious for two reasons. First the smaller globe and, secondly, because it was found possible to locate the battery in the same room (actually in part of a built-in cupboard which the housewife found inconvenient to use) and this reduced the length of run involved.

Where the wire was broken at the switch block an "inlet" socket was also fitted, enabling the charger to be connected to the battery and a near-by power point with a minimum of effort. The charger, originally built for more arduous work, has a capacity of 5 amps, and only needs to be connected to the battery for a few hours after each blackout.

My friend lists the following advantages for his installation.

(1) It costs practically nothing.

(2) The light, while not as bright as the "light that failed," is as bright or brighter than most other forms of emergency light.

(3) It is available, without fuss or bother, at the touch of a switch.

(4) It can be located where kerosene lights would be dangerous, i.e., near the ceiling, where it is most useful and reduces troublesome shadows to a minimum.

EXTRA LIGHTS

For the coming winter some extensions to the system are being planned. On the basis that even lower wattage lamps are adequate in many cases, it is intended to run leads to other parts of the house and provide at least sufficient light to permit safe navigation in hall, bathroom, bedroom, &c.

Where it is necessary merely to see where one is going and to avoid treading on the cat, ordinary 6 volt .3 amp panel lamps are quite adequate, while 5 watt globes, as used in tail and side lamps, will suit where something a little brighter is required. Because of the low current consumption, the wiring does not present any particular problems and runs of almost any reasonable length may be made using twin flex or single VIR 1/.064 or 1/.044.

Lights of this kind, particularly the panel lamps, have a value quite apart from blackouts. Used to light a tricky turn in a hallway, or a dangerous step, they may be operated from a small transformer and drain so little current from the mains that in most cases the meter will not register this amount alone. Thus they may be left burning all night if desired at virtually no cost, but providing considerable convenience.

If operated at a slightly reduced voltage, either due to line losses or by the addition of some resistance to the circuit, the life of the globes will be considerably lengthened. The writer uses such a system to light a hallway, and a panel lamp, operating on five volts, has been burning all night and every night for over five years! When it finally does pass out I won't begrudge the shilling or so to replace it.

DC OPERATION

Such a lighting system, or an elaboration of it, may be switched from transformer to battery in the event of a blackout, thus permitting free movement around the house without the inconvenience or risk created by candles or oil lamps.

Whether the change-over is effected manually or automatically will depend on your own ingenuity, but my friend is planning for a suitable relay to be energised from the mains (through the transformer and a disposals "two bob" rectifier) and so wired that the low wattage system will normally be connected to the transformer. When the power fails the relay will drop out and change the system over to the battery circuit. An additional refinement might well be a panel lamp in the kitchen to prevent falling over a chair while looking for the blackout switch.

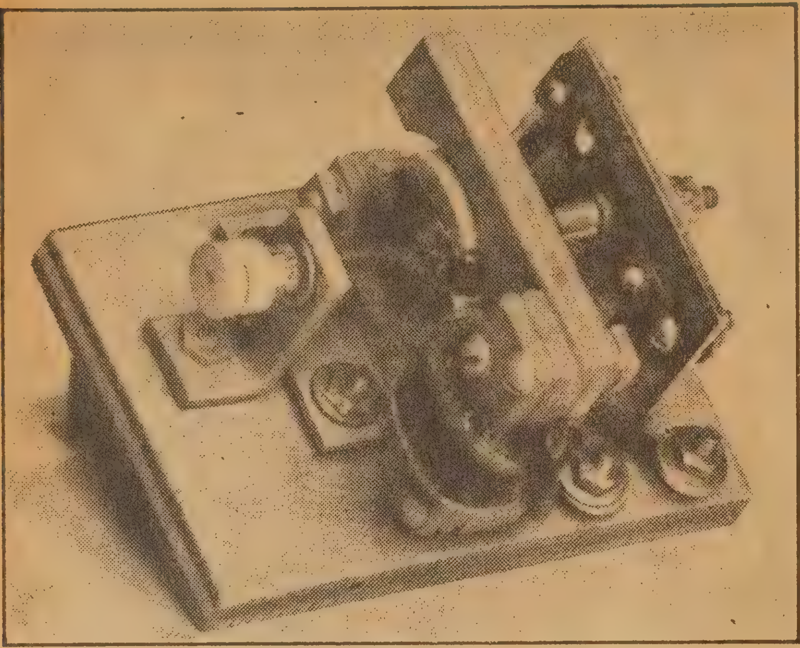
And speaking of disposals rectifiers raises the point about their possible use for charging the battery. The small ones, normally rated at 100 mA., when connected to an 11 volt transformer, will charge a 6 volt battery at between 50 and 75 mA., depending on the condition of the battery and the line voltage. While this, at first glance, may appear to be too low a rate to be of any value, it must be realised that there is a very high ratio of charge time to discharge time and discharge rates of 5 amps or less could probably be handled quite easily by such a charger working continuously. Because the rate is so slow there is little danger of damaging the battery by overcharging.

In many cases more harm results from insufficient charging than from overcharging, and you may expect many years of service from a battery if you make it a rule never to leave it in even a partly discharged condition. During the summer, when the system is idle, make sure that it is placed on charge every four to six weeks. You will also protect the battery terminals, as well as reducing resistance losses, by using terminal clamps rather than heavy duty clips.

Finally, don't forget that all such systems should be adequately fused, for there is a considerable quantity of power stored in an accumulator and a short circuit can have very serious consequences if there is no proper protection.

There are, of course, many possible variations of the above schemes, some of which will suggest themselves by virtue of the particular conditions, but whatever the requirements it should be possible to evolve something suitable from these ideas.

So here's wishing you brighter blackouts.



The finished three-pole self-starting motor. It takes longer to make than any of the others but the results are well worth while. See plans on page 87.

BUILDING ELECTRIC MOTORS

Following last month's article which explained the operation and described how to make a simple electric motor we present designs for two more motors which can be made at home without the aid of machine tools. Electric motors are such fascinating devices that you will want to build all three. Both motors described this month are capable of doing useful work and the second is a smooth-running self-starting job.

by Maurice Findlay

LAST month's motor was deliberately designed to be simple, our object being to demonstrate the principle of operation rather than turn out a powerful precision piece of work. It can be made by a person without any previous experience, in the course of a single evening.

However, a powerful and reliable electric motor is quite a different proposition. Some of the parts must be made with a certain degree of precision or the performance will suffer.

We have built up several electric motors, deliberately limiting ourselves in the scope of the tools used, with the object of determining the best approach from the point of view of the home constructor. The two motors described this month are the result of this experimental work.

The first is a logical practical interpretation of the diagram given in the February issue showing the principle of operation of the simple motor. Essentially, it consists of two electromagnets.

An electromagnet is used to produce the stationary field since permanent magnets are not likely to be available to readers in the required shape and size.

The second electromagnet is balanced on a freely rotating shaft and revolves between the extremes of the field produced by the first.

On the same shaft as the second electromagnet, or armature, is mounted the automatic switch which reverses the direction of the current in the armature as the shaft rotates This switch, or cummutator, must be precisely made and of robust construction since it is required to operate continuously at high speed.

The stationary elements of the switch which make contact with the rotating segments of the commutator are called brushes. In modern electric motors they do not look very much like brushes but the name is still used because brushes made from wire were used for the same purpose in early electric motors.

Commercial electric motors employ "brushes" made from a special grade of carbon but these are likely to present difficulty to the home constructor because, in order to operate efficiently, they should be used with a commuter turned to shape with a great deal of presision and, furthermore, they require mounting arrangements rather more elaborate than most readers would want to make.

Therefore, for the brushes in both motors we have used pieces of sheet brass bent to the required shape. You may be able to buy the sheet brass from the hardware store at the same time as the other metal parts. If not, you could use the strip brass terminals from a cycle lamp or torch battery. This applies to both motors.

FIRST MOTOR

For the baseboard of the first motor you will require a piece of wood or ply measuring 3in by 4in. Although the positions of the holes are marked in the diagram it is always a good idea to leave the drilling of these until last to allow for slight inaccuracy in the metal parts.

Both the field and armature magnets are wound on ¼in diameter soft iron rod. Your local hardware store may not be able to supply material softer than ordinary mild steel but this is satisfactory. In any case, it will not cost more than a few pence. Failing the rod, look around for some ¼in bolts.

Two brackets of the shape shown in the diagram are required. They may be made from any non-magnetic material which happens to be available. Copper, brass or aluminium may be used, on no account use iron or steel as this will shunt the magnetic circuit and reduce the efficiency of the motor. The metal should be 16 gauge or greater thickness in order to provide a reasonably wide bearing surface for the armature shaft.

You will also need some 1/8th inch nuts and bolts, an insulating radio stand-off pillar, a short length of 5/16in brass or copper tubing and a length of 24 gauge enamelled copper wire.

The first step in the contsruction is to bend the field magnet to shape. About the only satisfactory way to go about this involves the use of a vyce. Bend the metal into a "U" shape with the vertical sides of the "U" parallel and 2½in long. The bottom part of the magnet is 1½in long measured from inside to inside. Be careful to keep it straight and at right angles to the sides so that the coil is easy to wind.

Having bent the field to shape you can proceed to the two brackets which support both the field and the armature. The feet should be bent accurately at right angles to the upright section and, once again, a vise is the only satisfactory way of performing the operation.

Drill the holes in the brackets according to the diagram. If you have bent the field accurately to shape the two ¼in holes will be 1¾in apart but, since there is sure to be some slight inaccuracy in the bending of the field coil, it is better to transfer the exact measurements from the field coil to the brackets and drill the holes accordingly.

These plans will make it easy for you to build the simple two-pole motor shown below.

The 1/8in hole must be drilled exactly in the centre of the holes supporting the field. Inaccuracy here will tend to reduce the efficiency of the motor because it will not be possible for the armature to revolve as close to the poles of the fields as is desirable.

Put the field and its supporting brackets aside for the time being and concentrate on the armature and commutator.

The armature is also made from a piece of ¼in rod. Cut off a piece of rod 1 5/8in long and drill a 1/8in hole through the centre of its length, making sure that the hole is exactly at right angles to the axis of the rod.

In the finished motor the armature will be a little less than 1½in long but, without the aid of precision tools, it is very difficult to position the centre hole with sufficient accuracy. The idea is to mount the armature on its shaft and then file off the ends so that they both only just clear the field. The more precisely the job is done the better the performance of the motor.

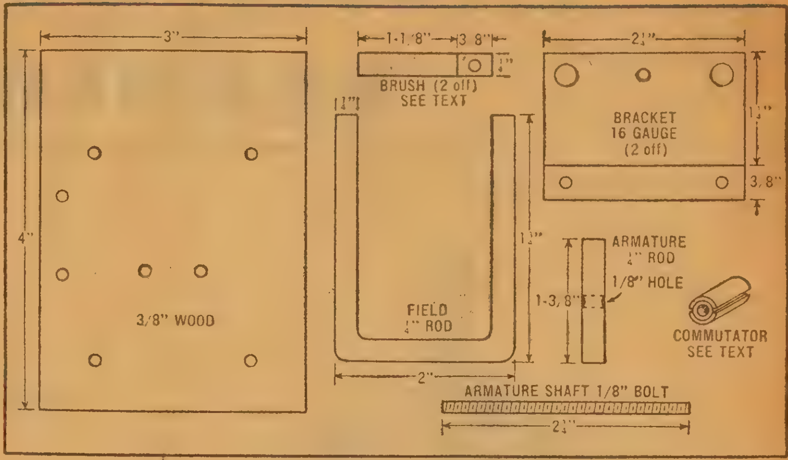
THE COMMUTATOR

Perhaps the most difficult part to make is the commutator. We tried several fancy schemes to simplify the job but eventually came back to the old well tried formula which has proved itself the most satisfactory over a period of time.

The raw materials are a threaded stand-off pillar cut off to a length of about ½in and a piece of thin-walled copper or brass tubing of the same length. The idea is to select the rod and the tubing so that the latter fits tightly over the former. In our case we were able to select a piece of rod which would fit accurately into a piece of thin-walled tubing having an outside diameter of 5/16in. We do not recommend that you use tubing much larger than this as the friction introduced by the brushes is likely to have too great a retarding effect on the motor.

Should you not be able to obtain pieces of tubing and rod to match, the best approach is to reduce the size of the insulating rod so that it can be pressed into the piece of tubing. One way of doing this is to screw a bolt into the insulating rod (radio stand-off insulators are normally provided with a 1/8in whit. thread) and grip the bolt in the chuck of a drill.

PLANS FOR THE SIMPLER MOTOR



If it is an electric drill it is a simple matter to reduce the diameter by the correct amount with the aid of a file while the drill is held in the vise. With a hand operated drill however, it will be necessary to have an assistant turn the drill at a good pace while you concentrate on the filing operation.

Roughen the inside of the metal tubing with some coarse emery cloth and then apply a coating of cellulose cement. Also apply a coating of cellulose cement to the outside of the ebonite rod and force the rod into the tubing. If the rod is a good fit most of the cement will be forced out leaving a very thin layer which forms a strong bond between the two.

Cellulose cement is available in branded tubes, while hobby stores keep stocks for the benefit of model aeroplane enthusiasts. Alternatively, clear nail polish may be used with equal success. Allow the cement plenty of time to dry before proceeding further.

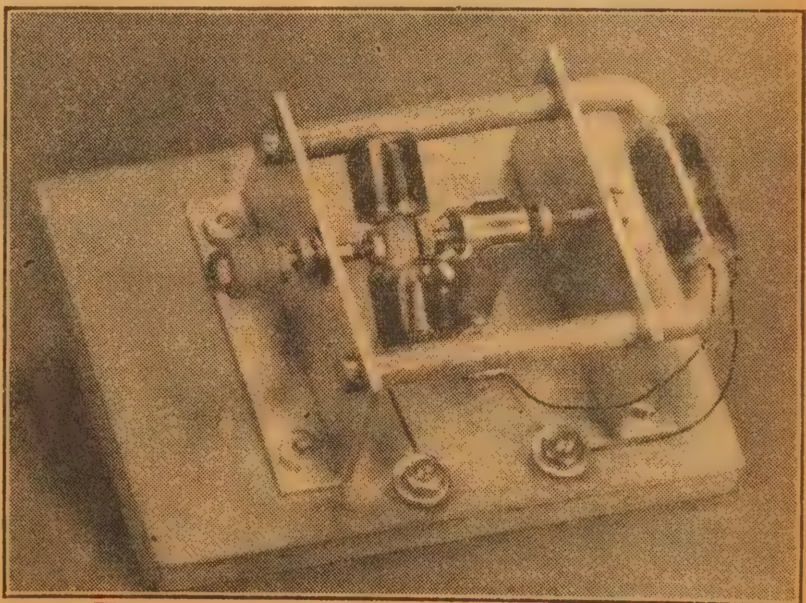
The next job is to separate the segments of the commutator. Probably the best way to go about this is to grip the unit gently in the vise, then, with a hack saw or a coping saw make a cut through one side of the brass holding the blade parallel to the jaws of the vise. Cut into the insulating material only far enough to ensure that the metal is separated.

Turn the commutator over and repeat the operation on the opposite side taking care that the two cuts are exactly opposite each other. With the brass tubing now separated into sections it will be held in place by the cement alone so that it should not be gripped in the vise with any more pressure than necessary.

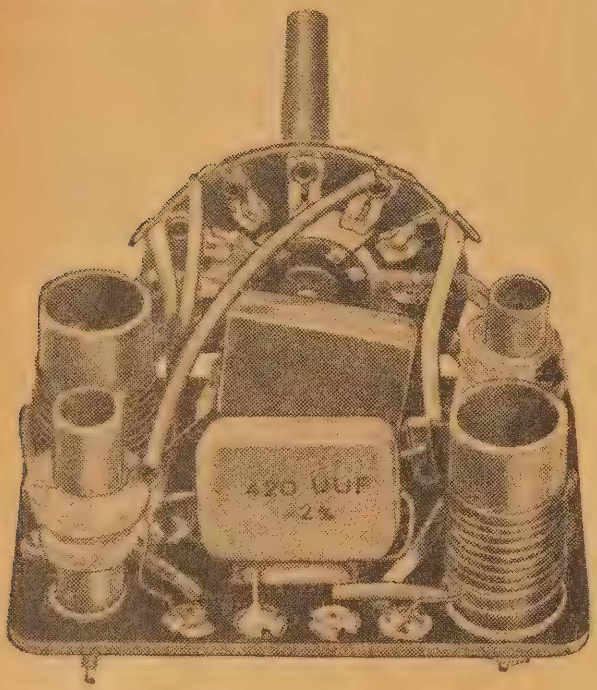
FIELD COIL

With the main parts of the motor shaped you can now proceed to the winding of the field coil and armature. To obviate the possibility of the wire making connection with the iron core it is a good idea to paste a layer of paper over the iron where the coil is to be wound. Cellulose tape is suitable and has the advantage that you do not have to wait for the cement to dry.

Using 24 gauge enamelled wire (or



This simple motor develops plenty of power and is easy to build.




HOMECRAFTS
BARRACK ST.
KING ST.
CLARENCE ST.

slightly finer if you wish) wind on four layers about 1in long making a neat coil with all turns close together. You will probably get better results if you put a layer of tape or paper between each layer of wire, the paper preventing the top layer from disturbing the layer underneath.

With the field coil complete you can proceed to the job of winding the armature. Here we will digress for a moment to discuss the problems involved in assembling the armature and commutator on the drive shaft.

Very few of our readers will have access to a lathe so that we have to rely on machined parts which are readily available. For the ease with which it faciliates the holding of the armature and commutator a length of threaded rod is excellent. A nut on either side of the armature can be used to hold it firmly in place without any difficulty. The same applies to the commutator with the only difference that it is desirable to include an insulating washer on either side of the commutator to prevent a short circuit between the sections.

However convenient it may be for holding the parts in place, the threaded rod does not offer a very good bearing surface. The tops of the threads tend to wear very quickly, making the shaft loose in the bearings. Friction is also increased because the shaft is continually trying to screw itself in the direction of its length.

This is an exact-size tracing of the armature stamping used in the 3-pole motor. You may be able to purchase them ready-made.

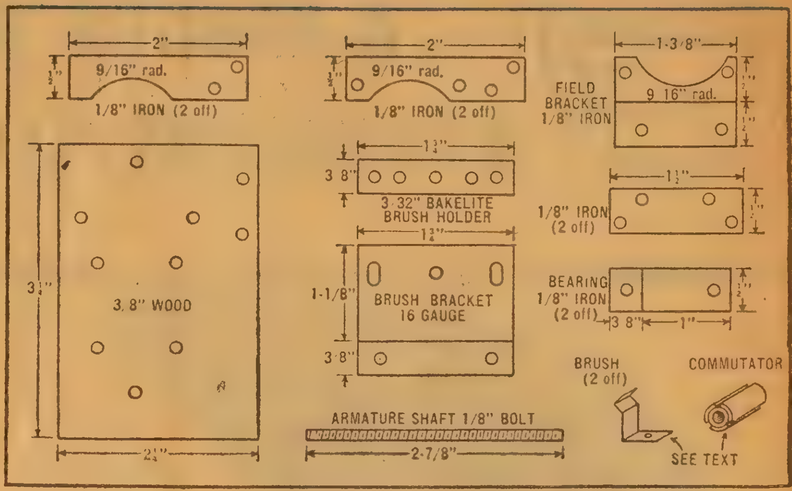
One solution to the problem is to solder a short length of metal tubing over the threaded rod at the bearings after the armature and commutator are firmly secured in place. If you use thin-walled tubing of a diameter such that it just fits over the shaft the overall diameter of the shaft at the bearing points will not be increased unduly.

A compromise bearing can be made by filling in the appropriate part of the threaded rod with solder and then filing it back to the level of the rest of the rod. Again, this operation will have to be carried out after the armature and commutator have been secured in place. The nuts which keep the shaft in position lengthwise may be screwed up tight against the solder avoiding the need for lockwashers.

BETTER SHAFT

Of course, if you have the facilities for carrying out machining operations you will be able to turn out something to better either of these schemes. You could start with a shaft, say 5-32in diam. and cut a suitable thread the length of the rod. The ends can then be turned down to a smaller diameter to form a smooth bearing. The bigger motor is well worth a pair of miniature ballraces if these are available. We

PLANS FOR THE 3-POLE MOTOR



There is more work in building this 3-pole motor but it is an excellent proposition for driving small models.

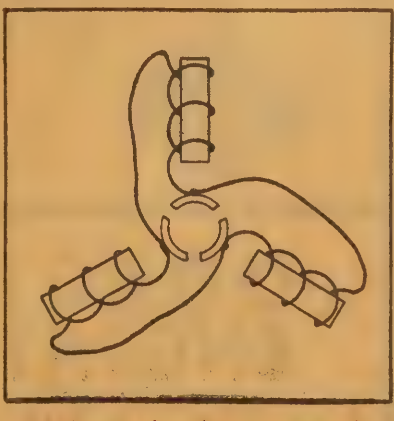
proach to the problem of the bearings is best in your case.

The winding of the armature is not a difficult job. Remember that the windings on both sides of the shaft must be in the same direction and also that they must be insulated away from the metal part of the armature. Since the armature will revolve at high speed it is necessary to have the windings firmly anchored in place. A coat of cement used to make the commutator will serve the purpose admirably. Wind on four layers of 24-gauge enam. wire on each side of the armature.

After winding one side take the wire across to the other side unbroken so that when you have finished you will be left with two bare ends. Cut the wires off to such a length that they can be soldered to the commutator segments, allowing a little slack for adjusting the position of the commutator.

SOLDER QUICKLY

One of the defects of the cellulose cement is its inability to withstand high temperatures, so, before soldering make sure that both the



This diagram shows how to connect the armature coils to the commutator. Position the commutator in relation to the armature as shown.

wires and the commutator segments are perfectly clean and have a thin smear of flux applied. A very quick application of a hot soldering iron will then serve to make a good connection without destroying the cement.

The motor will develop maximum power when the cuts in the armature segments point in the same direction as the armature poles, but select the exact position by experiment. A nut on the armature shaft screwed up tight against the commutator will lock it firmly in the position your experiments prove to be the best. It is best to adjust the position of commutator with the motor running at a low speed, which it will do when connected to a battery of lower voltage than that for which it is designed.

Incidentaly, when wound with the 24-gauge wire suggested, the motor is best suited to operate from a 4-volt DC suply. It will run quite well on 2 volts, but would have sufficient power for only the smallest models. When connected to a 6-volt battery the windings tend to overheat somewhat so that, if a 6-volt supply is most convenient for your particular purpose, we suggest that you wind the motor with wire several gauges lighter, but use more turns.

CAR BATTERY

The motor requires several watts of power so that it is uneconomical to use dry batteries. If you do not have an accumulator at home, the local garage man may be willing to sell you one that has served its useful life in a car, but is still good enough for electric motor experiments. Sometimes batteries develop faults in one or more cells while the remaining cells are perfectly okay.

In such a case you could short the faulty cell with a length of wire and use the remaining cells or driving the motor. Even though useless for its original job in a car, the battery still has some value because of the case in particular, so that the garage-man will be justified in charging you

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for the battery plus a fee for bringing it up to full charge.

By the way, motor car batteries are capable of delivering sufficient current to melt a thick piece of wire so that it is foolish to try connecting leads across the terminals in order to observe the fireworks. Not only will you waste the energy in the battery, but you run the risk of being left holding a few lumps of molten copper—all that remains of the original wire.

USE ON A.C.

A transformer provides another solution to the problem of supplying power to operate the motors. Any transformer capable of 6 volts at up to 2 amps will be suitable. When operating from the alternating current supplied by a transformer a slightly higher voltage may be applied to the motor than when it is operating from a storage battery.

At this stage we would like to issue a warning to those who have not had any previous experience with electrical circuits, particularly those connected with the power mains. If you are in doubt, enlist the aid of a more experienced friend as under certain cicumstances the power mains are capable of administering a fatal shock. However, if the primary leads of a suitable transformer are properly wired you can play around with the secondary leads as much as you please without the possibility of a shock.

THE SECOND MOTOR

All the foregoing remarks about power supply arrangements apply equally to both motors as do the remarks about the bearings so that there is no need to repeat the remarks in relation to the second motor.

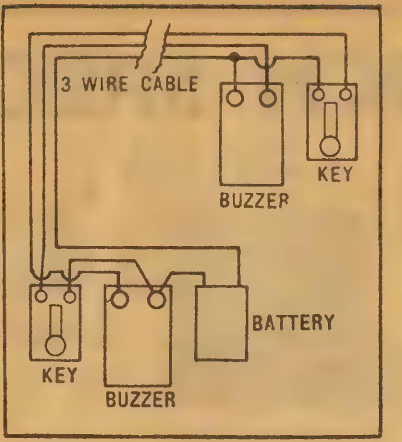
The simple motor sometimes requires a push in order to start in rotating. You can easily see that in one particular position the brushes will short the two segments of the commutator so that the current will not flow though the armature winding at all. Furthermore, the magnets only develop a strong pull when they are close together.

In some cases this will not be of great importance, but if, for example, you wish to install the motor in an electric train it would be a disadvantage to have to give the train a push to start it rolling after every time it stopped. Perhaps it wouldn't matter so much in the case of a toy windmill or other stationary model.

If a motor is to be self-starting, it must be arranged so that, no matter what the position in which the armature stops, the magnets will always be in a position to pull it in the direction of rotation when the current is switched on again. If this is to be the case, it is necessary to have an armature with three or more poles. The requirements for the field coil are much the same as for the simple motor, although it is possible to make some improvements in this direction.

IRON STAMPINGS

You could file out all the parts required from raw materials, but it would be such a long and tedious job that you would probably leave it half finished. Occasionally we have seen complete kits of field coil and armature stampings for sale at hobby stores, but suppiies are very uncertain. However, supplies of the armature stampings separately seem



There was a slight error in this circuit when published in the January issue. Here is the correct version.

to be in good supply and, with the armature stampings ready made, the problem of making the field does not appear so formidable.

The particular stampings we used are 1in diameter and have 1-8in hole drilled through the centre. Besides the iron for the core of the armature, thin fibre stampings of the sam shape are available and these ca be placed outside the iron stamping to assist with the insulation. Withou the fibre pieces it would be neces sary to wrap the winding slots care fully with paper to prevent the pos sibility of the enamel insulation o the wire being chipped off by th edges of the metal.

The field coil for the larger moto is made from ½in by 1 1-8in soft iro or mild steel stock. You will nee four pieces 2in long and pieces 1½in long. The fou longer pieces require filing t the shape shown in the diagram i addition to the 1-8in holes.

CARE NEEDED

If the motor is to fit together ac curately, the positions of the hole must be marked out with a grea deal of care. A small error in th positions of the holes makes a bi difference to the layout of the field

If, after you have made the part as accurately as possible the field wil not fit together with the longer piece perfectly parallel, try drilling th holes out to something larger tha 1-8in, say, 5-32in, so that a certair amount of adjustments, will be possible. Don't forget to include a spring washer under each nut.

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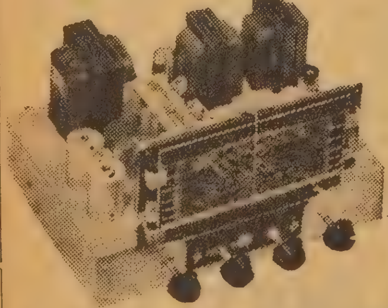

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[illegible] this motor the brackets are bent up from the same ½in by 1-8in stock used to make the field. They measure 1in by ½in and the hole is ¾in up from the level of the baseboard.

A special bracket is used to hold the brushes which are arranged so that they can be adjusted to the optimum position while the motor is running. It is 1¾in wide and 1 1-8in. by 3-8in. We used a piece of 18-gauge aluminium, but anything similar will serve. The brushes themselves are mounted on a strip of bakelite measuring 1 1-8in by 3-8in by approx.. 3-32in thick. A 5-32 in hole is drilled through the centre to take the armature shaft without rubbing and two other holes, each 3-8in from the centre are drilled and countersunk on one side so that the heads of the countersunk bolts holding the brushes will not touch the supporting bracket. When the motor is complete and running the brush assembly may be rotated around the armature shaft until a position is found in which the motor develops maximum power.

SAME PROCEDURE

Follow the same procedure in making the commutator as for the two segment commutator described earlier, except that it will be necessary to exercise greater care in marking out the positions of the cuts and in handling the unit in the vice.

Anticipating that many readers would wish to run the motor from a transformer at a somewhat higher voltage than that suggested for the simpler motor, we used 28-gauge enam. wire (finer than 24 gauge) to wind the coils.

As it is, the motor works excellently on from 4 to 6 volts DC and from 6 to 8 volts AC. Of course, if you wish to have the motor operate from a lower voltage you could wind the coils with slightly thicker wire. There is a limit to this, however, as if you use very thick wire and try to operate the motor from, say, 2 volts the contact resistance of the brushes will no longer be negligible and a lot of power will be wasted in the form of heat.

FIELD COIL

The field coil consists of 10 layers of wire each ½in wide. Cement a layer of paper over the metal to obviate the possibility of a short circuit before winding on the first layer and another layer of paper under every second layer of wire until the coil is complete.

Each of the three armature bobbins is also wound with 28-gauge wire. The first four or five layers can be wound into a neat coil quite easily, but after that you will have to rely on a scramble winding technique to fill up the bobbin. Aim to have an approximately equal number of turns on each coil. When all three coils are complete scrape the enamel off the ends of the wire, and solder them to the commutator, as shown in the diagram, again, taking care not to damage the cellulose cement by excess heat.

From now on it is simply a matter of assembling the parts on the baseboard. If everything has been made accurately, little or no fitting will be required except that, because we have allowed for only a small amount of clearance, the armature may tend to rub on the field. The relative heights of the armature and the field can be adjusted by putting a piece or pieces of tinplate under the armature or bearing brackets as required. If you drill the holes in the brackets supporting the field a little larger than 1-8in you will have a little extra latitude in the matter of positioning the field.

By the way, both motors are connected up in just the same way as the little motor described last month. From one terminal take a wire to one of the brushes, from the other brush take a wire to the field coil and the remaining field coil wire returns to the remaining terminal. If you wish to make the motor turn in the opposite direction reverse the connections to either the brushes or the field coil, not both.

TERMINALS

It is desirable to have terminals on the baseboard so that you can connect the motor to a battery or transformer without the possibility of damaging the windings. A pair of very effective terminals can be made from two bolts and some nuts and washers. Drill a hole through the baseboard and countersink it underneath with larger drill. Push the bolt up through the hole and screw a nut on from on top at the same time securing the bare end of wire under the nut. Then, put on two washers and a second nut. Wires going to the battery can now be gripped between the two washers.

The completed motor has about the same power as the electric motors sold with mechanical construction sets and will do a good job of driving the models you can build with them. Most of these constructional sets use rods 5-32in diam, so that you will have to adjust the end of the shaft to take this size if you wish to attach gears from the set directly to the motor. A piece of very thin sheet brass could be used for this purpose. Alternately you could cut out a pulley wheel as shown in the photograph and drive the model through a rubber band.

Remember that the motor likes to work at a good speed, and in most cases you will get best results if you put the small wheel on the motor and the big wheel on the model.

The last three articles in the series have placed emphasis on the practical side of the subject. Mention has been made of such things as "voltage" and "resistance" and connecting batteries in series and parallel. Next month we will devote an article to the subject which will answer some of the queries you may have about these things.

WE HAVE NOTICED:

- That some suburban listeners are unaware that they owe anything at all to a radio in the form of an aerial. A picture-rail installation instead of being an easy way out has become a lot of trouble. In difficult spots it's as important as ever to use a good aerial and preferably an earth as well.

- That some have the idea an aerial is introducing noise, simply because the set makes more noise when the aerial is connected. Of course an aerial will pick up noise, but if it picks up a still greater amount of signal you're better off. The important thing is not just noise but the signal-to-noise ratio.

EC91 GROUNDED-GRID AMPLIFIER

The sensitivity of a V.H.F. receiver is largely determined by the first valve. In most cases the design is a compromise between good performance and simplicity of construction, and a circuit which meets both requirements is of great value. In this respect the EC91 grounded-grid triode is a very useful valve in the 100-250 Mc/s frequency range.

The signal-to-noise ratio which can be obtained in a receiver with a given signal voltage at the aerial terminals is limited by two factors, receiver noise and noise radiation external to the receiver. At frequencies up to 90 Mc/s the external noise level due to atmospheric interference or noise radiation from the Milky Way is relatively high and only a small increase in signal-to-noise ratio can be achieved by reducing the receiver noise below that of a modern high-frequency pentode such as the EF91. At higher frequencies, however, the receiver noise becomes progressively more important and improvements in the receiver will give an effective increase in signal-to-noise ratio.

The receiver noise at V.H.F. is almost entirely dependent on the equivalent noise resistance and input impedance of the first valve. The triode is superior to the pentode because (a) partition noise (due to random current divisions between screen-grid and anode) is absent, (b) negative feed back by an impedance in the cathode circuit has little effect on the signal-to-noise ratio, and (c) the signal-to-noise ratio is less critically dependent on the aerial coupling.

Various circuits have been devised to make a triode amplifier stable at high frequencies, and of these the most simple is the grounded-grid circuit in which the grid is used as a screen between input and output. The EC91 miniature triode (B7G base) has been designed for grounded-grid operation and is particularly suitable for the frequency

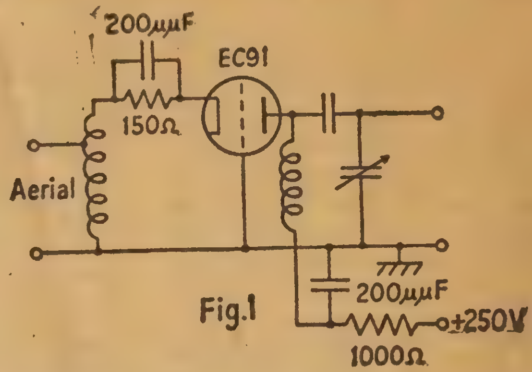


Fig.1

range 100-250 Mc/s. The static characteristics are summarisec below:

Vh	6.3V	Va	250V	ra	12,000 ohms
Ih	0.3A	Vg	-1.5V	Req	400 ohms
ca-g	2.5uuF	Ia	10mA	wa max	2.5W
Ca-k+h	0.2uuF	gm	8.5mA/V	Ik max	15mA
Cg-k+h	8.5uuF	u	100		

The feedback input impedance of a grounded-gri amplifier is approximately 1/gm when the load resistanc is small. The input circuit may therefore have a very wid bandwidth (about 100 Mc/s) without the deterioration i signal-to-noise ratio which a damping resistor would produce The receiver construction may be simplified by leavin the input circuit tuned approximately to the centre of th frequency range. The signal-to-noise ratio is not criticall dependent upon the aerial coupling.

A typical EC91 circuit which has been used at 180 Mc/s i shown in figure 1. The aerial tap is about 2/3 of the tunin coil for an 80-ohm source. The measured sensitivity (fo unity signal-to-noise ratio) expressed as an open-circui signal voltage at the aerial terminals was 3.5 times the squar root of delta f in microvolts where delta f is the banc width in Mc/s. This figure was measured at the output o the last intermediate-frequency amplifier.

PROCESSING YOUR BROMIDE PRINTS

IT is assumed that you at least have access to an enlarger, even if you do not own one, and that you have acquainted yourself with the mechanics of the device and feel ready to make your first attempt at enlargements.

We cannot approach the job of making an enlargement in quite the same way as we do that of contact printing. Firstly, the cost of a large sheet of paper is much greater, and waste must be avoided if the cost per print is to be kept within reasonable limits.

Secondly, we have an additional variable, in the form of the degree of enlargement, which effects the printing exposure required and makes the estimation of this rather critical factor considerably more difficult. This is made worse by the fact that bromide papers usually have less latitude for compensation by development than the contact varieties.

BETTER QUALITY

Again, it is fairly safe to assume that a large print will be subjected to a more critical scrutiny than a small one, so that the natural desire is to make such a print near perfect as possible. All these factors add up to the need for a more methodical approach than is, perhaps, necessary for contact work, or, in fact than is often advised for handling bromide papers.

The reader may be better able to appreciate some of the problems if we detail the major conditions which must be fullfilled in order to produce the best possible print.

(1) The correct grade of paper must be chosen to suit the contrast of the negative.

This is the appearance of a test strip made with the mask described in the article. The figures near the centre represent the exposure time in seconds, the final print being made slightly lighter than the 10 seconds strip. Tests as large as this are seldom necessary and a 2" quare of paper is usually adequate.

Last month we had something to say about the properties of bromide paper and the next logical step is the handling of this material. In this article we discuss the beginner's approach to such things as exposure, development, contrast, &c, as well as some of the properties of paper developers.

(2) The paper must be correctly exposed.

(3) It must be developed for the correct length of time.

It is an unfortunate fact that many text books tend to by-pass these problems with a vague statement along the lines of ". . . a little experience will enable you to judge the correct exposure (or development). . . " and so on, leaving the unfortunate beginner with two or three unknown factors and only the vaguest idea how to go about getting some order out of the chaos.

As a result most beginners get away to a very bad start, making their exposures by guess and developing until the print looks about correct. This apparently on the assumption that errors in exposure can be compensated for by adjustment in development time. In fact, this latitude is extremely small and such methods can only lead to poor quality prints except on the few rare occasions when the correct exposure happens to be "fluked."

The professional photographer may appear to work to this formula —and get away with it—but the truth is that it can hardly be classed as guesswork. After all, he has had years of experience and spends some part of every day in the darkroom, so it is not surprising that he can assess the value of a negative or a projected image with a high degree of accuracy.

The amateur, and particularly the beginner, is in quite a different catagory. Not only does he lack experience, but he also lacks the opportunity to acquire it with the same speed as the professional. Far from being in the darkroom every day many amateurs will not have the need to enter it for weeks, or even months, at a time. Thus the experience gained at one session will have faded from memory by the time the next batch of work is to be done, and one must start all over again.

It is far better, therefore, to start on the basis of methodically determining the correct value for each process before proceeding with it, even though it may appear to take longer. Actually, it is more likely that you will save time in the long run, to say nothing of the saving in material.

More important still, you will establish the best possible standards of print quality so that, when you decide that experience and estimation can take the place of measurement, you will be better able to judge whether you are turning out the best possible results by the new method.

How, then, should the beginner tackle the problem?

EXPOSURE

The first item we listed was that of contrast, or selecting paper grade to suit the negative. While this is an important point, it will be easier to discuss after we have had something to say about exposure so, for the moment, we will leave it in abeyance.

The exposure is probably the most critical of the three, it being impossible to compensate for more than a very small variation from the optimum value. So far there appears to be no really satisfactory substitute for a trial print or test strip and, even though it means the expenditure of time and paper, it is by far the best method for the beginner.

The simplest metnod of making a test strip is to place a narrow strip of paper on the baseboard where it will be exposed to an important part of the negative and give the whole strip, say, five seconds exposure. Then cover about a third of it and give another exposure of five seconds. Now cover two thirds and expose the remainder for 10 seconds. This will give three exposures of 5, 10 and 20 seconds and upon CORRECT development the best exposure can be determined.

If none appear correct it may be necessary to make a second strip or to select a time intermediate between two of those chosen.

OTHER METHODS

An elaboration of this system provides the equivilant of several exposures on one piece of paper by exposing the paper through a step wedge, or a sheet of film having a number of areas of different density which produce the effect of varying exposure times.

The main disadvantage of both these methods is that it does not allow comparison of different exposures of the same part of the negative, something which is really essential for best results.

This can be overcome by using three separate pieces of paper and exposing each to the same part for the required times, but the handling of three strips takes extra time, exposing will take longer, and developing is not so convenient. Nevertheless, it is better to tolerate such slight inconvenience than to spoil a large sheet of paper.

Greater convenience is provided by the use of a simple masking device which enables four exposures, all of the same part of the negative, to be made on one piece of paper. Commercial versions of these are available, and they also carry useful tables showing variation in exposure times with variation in enlargement.

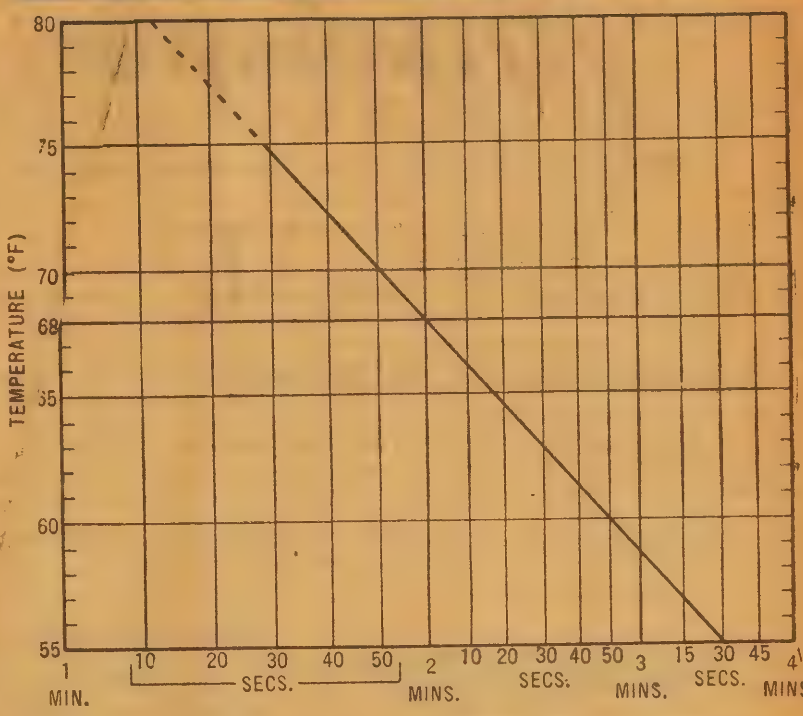
The general idea can be obtained from figure 1, where the mask is shown protecting all but a quarter of the test strip. This latter is pivoted in the centre with a drawing pin or similar arrangement so that, when the uncovered section is exposed, a new portion may be readily moved into place. To do this it is only necessary to place a pin or similar sharp point at "A" and move it to position "B," thus rotating the paper through 90 degrees. When the new section is exposed the process is repeated until all four sections have been treated.

SIMPLE MASK

It is not difficult to make such a mask from a piece of cardboard, it and the paper being simply secured to the baseboard with a drawing pin. It is advisable to make it rather larger than the print likely to be needed, otherwise it may be hard to hold it steady while the paper is being rotated. The size of the paper may then be selected to suit the particular conditions, remembering that a scrap of paper 2" x 2" will give four images each 1" x 1."

This scheme, while very good, has

DEVELOPER TIME-TEMP. CHART



This graph will help the beginner to appreciate the effects of temperature on print developing time. It is designed for use with Dektol developer, diluted 1 to 4 and the line may be moved to the right or left to suit papers requiring other times at 68 degrees.

the slight disadvantage that four tests are hardly necessary, three usually being sufficient. Also some care is necessary if the use of square pieces of paper for tests is not to produce a series of scraps which are unsuitable in size or shape for use with the mask. However a little thought before cutting should prevent this, an example being the popular 6½" x 4¾" paper, which may be cut into six pieces each approximately 2 1/8" square.

It is particularly important that the exposures given to a test strip should increase by a multiple, such as two, rather than by the addition of the same amount of time to each preceding exposure. Thus a typical set of exposures should be 5, 10, 20, 40 &c., rather than 5, 10, 15, 20 &c. since in the latter case the increase from 5 to 10 is much greater relatively, than that from 15 to 20.

JUDGING THE TESTS

The factor of two will be found satisfactory in most cases, but it may be varied if required. The need for a lower factor is sometimes experienced when working with high contrast paper and it may be more convenient to reduce it to, say, 1.5, giving values of 5, 7.5, 11, and 16 approximately.

The next step is to develop these test exposures correctly — about which we will have more to say in a moment — and then examine them for correctness of exposure and contrast. The ideal exposure is one which reproduces the densest part of the negative as pure white paper with no metalic silver visible. Every negative density which is less than this should then produce some silver deposit, even if very slight.

If the correct contrast grade of paper has been chosen such an exposure will result in the thinnest part of the negative producing the best black of which the paper is capable, while all slightly denser areas will be slightly lighter in the print. For a number of reasons, including those discussed last month, this ideal is not always easy to achieve and it is often necessary to be content with something a little less.

Sometimes, for example, the most important part of the picture may require that other parts be sacrificed in tone value in order that it be presented correctly, so that either the shadows or the highlights may be distorted.

STANDARD WHITE

To assist in judging the print it is a good idea to arrange for a small area of the test to be completely covered during exposure so that a standard white will be available for comparison. View your test strips in a normal light for, if judged by too bright a light, they will appear brighter than when normally viewed and the finished print will be too dark. The reverse will be true if the light is too weak. Prints appear slightly darker when dry than when wet, so make some allowance for this also when judging your strips.

If it appears that one exposure is too dark and the next one too light it is usually safe to select a value intermediate between the two, but, if in doubt it is as well to make a second test at the intermediate value, and perhaps on a slightly larger piece of paper.

When you finally decide on the best exposure and grade of paper it is a good idea to write this inform-

ation on the back of the print, thus enabling you to make another copy at any time with a minumum of effort. Pencil is the best for this, and don't be tempted to use a ball point pen, as the markings can quite easily be transferred to the face of another print in the fixing or washing baths.

Where a number of negatives have been made under the same lighting conditions and with same exposure, it is usually safe to give the same printing exposure for all. There are exceptions, however, such as when the important subject may have been lighted from different directions, and these will need to be watched.

Now for the development procedure. Two important points must be clearly grasped at this point, (1) that the development must be for a definite time and the test strip appearance is of no significance, and (2) that whatever time is given to the test strip must also be given to the final print.

INCORRECT DEVELOPMENT

There is a very good reason for ignoring the appearance of the test strip. During development, first one and then another of the exposures will appear the best of those present and if the development is stopped as soon as one appears correct the result will be an over-exposed and under-developed print. While there may be no doubt that it is the best of the three, there is no guarantee that it is the best print which the negative is capable of producing.

Under-development is the most frequent cause of poor quality prints, resulting in low contrast and "muddy" blacks, sometimes with an unpleasant greenish tinge. Once the beginner can grasp the idea of maintaining correct print development he will be well on the way to making technically good prints. It is permissible to increase the development time slightly in order to compensate for an under-exposed print, but the latitude is not very great and prolonged development in an attempt to "force" an image will result in severe chemical fog.

Thus the ideal arrangement is to develop for a pre-determined time, select the best exposure from the tests, and then develop the print for the same time.

Which brings us to the burning question, "What is the correct time to develop a print?"

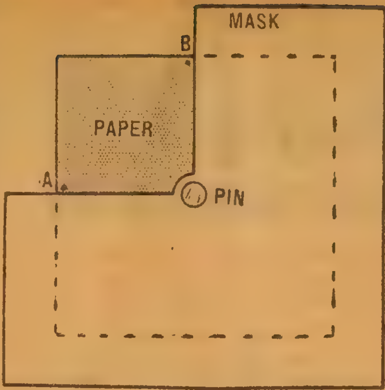
This is dependent on a number of factors, just as in the case of a film, such as the nature of the developer, the characteristics of the paper, and the temperature.

DEVELOPMENT TIME

Most paper manufacturers recommend a formula which they regard as most suitable for their product and, in many cases, this is available either ready-mixed or in powder form for mixing with water.

There does not seem to be a great deal to choose between most of these formulas, at least as far as their ability to produce a good print is concerned, though some may be a good deal better in such matters as keeping properties, print capacity without exhaustion, &c. One which gives satisfactory results on one make of paper will usually be satisfactory on others as well.

When the maker specifies a certain formula, he generally recommends the time for which the paper should be developed, the most usual figure



This shows the general idea of the mask used to produce the test print at the beginning of the article. The actual construction may be as simple or elaborate as your taste dictates.

being two minutes at 68 degrees F. Providing the temperature can be kept at this figure there is really no development problem, all test strips and prints being developed for this time with the assurance that this part of the process is correct.

Unfortunately, it is not as easy as all this. The constant temperature ideal is, no doubt, a worthy one but, as we have mentioned before in these articles, there are few amateurs who possess air-conditioned darkrooms or other facilities to achieve it. Thus, they are forced to develop at the prevailing temperature and again the problem is, for how long?

Makers and users agree that, as the temperature changes, the development time should be changed also but, so far, no one seems to have been able to give any kind of ruling as to exactly how much it should change. The idea of any kind of a time-temperature chart seems to be regarded as totally unnecessary even though the makers go to considerable trouble to point out the need for correct development.

One approach to the problem is that of factorial development. This uses the first appearance of the image as a guide to the rate at which the developer is working, the total time being a multiple of the "first appearance" time.

Thus, if the first appearance takes 30 seconds and the factor for the particular developer is five, the total time will be 2½ minutes. This scheme makes allowances for all such variables as temperature, developer ex-

(Continued or Page 111)

SHORT WAVE NOTES BY RAY SIMPSON

MORE NEWS OF SWEDISH TRANSMITTERS

The two new 100 kw transmitters of Radio Sweden are now in operation and, on at least one frequency, are being heard at very good strength in Australia. These new transmitters are located at Horby, though the old transmitter at Motala is still being used for the home service.

THE various services by Radio Sweden are the Overseas Service, the European Service, and the previously mentioned Home Service.

The complete new schedule is as follows:—

OVERSEAS SERVICE

English	Swedish	Frequency
NORTH AMERICA, EAST		
1000—1100am	1100—1245pm	6.065 mc
1000—1015pm	1015—1045pm	11.88 mc
NORTH AMERICA, WEST		
0200—0215pm	0215—0245pm	9.535 mc
0700—0730am	0730—0800am	9.535 mc
SOUTH AMERICA		
1000—1100am	1100—Noon	6.095 mc
0900—0915am	0915—0945pm	21.58 mc
0900—0915am	0915—1000am	6.095 mc
FAR EAST		
1100—1115pm	1115—1145pm	9.535 mc
0099—0915am	0915—0945am	9.535 mc
SOUTH ASIA		
0200—0215pm	0215—0245pm	9.62 mc
Mid.—1215am	1215—1245am	9.535 mc
1245—0130am	0130—0200am	9.535 mc
MIDDLE EAST		
0100—0115pm	0115—0145pm	9.535 mc
0300—0315am	0315—0345am	9.535 mc
AFRICA		
0300—0330pm	0330—0400pm	9.535 mc
0400—0415am	0415—0435am	9.535 mc

EUROPEAN SERVICE

Swedish transmission	0500-0530am	6.095 mc
German transmission	0530-0600am	6.095 mc
English transmission	0600-0630am	6.095 mc
French transmission	0630-0645am	6.095 mc

HOME SERVICE

0300—0700pm	6.065 mc
0700—0300am	11.705 mc
0300—0845am	6.065 mc

Sweden Calling DX ers is broadcast on 11.750 mc Saturdays at 1:15 am and also on 6.065 mc at 8.30 am. It is again given on this same channel at 5.15 pm. The Home Service is also broadcast throughout the day by one of the old 12 kc transmitters at Motala on 7.27 mc.

The Weekly News Reel can be heard on Sunday at 0715 am and again at 1015 am. This broadcast contains a brief news bulletin, interviews, glimpses from the life in Sweden, reports of big events and on-the-spot reports.

RADIO JAMAICA

OUR Victorian correspondent Mr. Alexander Talbert kindly sends along an interesting letter he has recently received from Radio Jamaica in answer to a reception report he had sent to the station.

After thanking him for his report they go on to say that their short-wave transmitter is operated on a vertical antenna system and is intended only to give good listening throughout the island. However, when weather conditions are favorable for skips they are occasionally heard in other parts of the world.

They also state they use a standard broadcast transmitter on 880 kc to cover the metropolitan area of Kingston but, owing to the mountainous terrain of the island, short wave transmission is also necessary for complete island-wide coverage.

Readers may be interested to know that ZQI was heard a few years ago when they were operating on 4.7 mc, but according to the latest lists they are now using 4.97 mc with alternate channels of 2.33 and 3.36 mc. The Cable and Wireless stations at Stoney Hill, Jamaica, have also been heard and verified over VRR4 on 11.595 mc and VRR5 on 12.05 mc when they were broadcasting cricket matches in the West Indies.

SHORT Wave Notes for the April issue are due on March 8. For the May issue they are due on April 5. Please send them direct to Mr. Ray Simpson 80 Wilga Street, Concord West, N.S.W.

Mr. Talbert also sends us an interesting letter he has just received from Radio Free Asia which in part reads as follows: "We appreciate your interest in the activities of Radio Free Asia. At the present time our programs are being relayed from our transmitter in Manila, which broadcasts on 6.11 mc.

"Our programs begin at 11.30 pm with a 35-minute program in Mandarin. This is followed by the same program in Cantonese. At approximately 12.15 am we broadcast the news and a commentary.

"This presently comprises our complete schedule, although we anticipate an expansion of our program service and an earlier starting hour in the very near future."

The letter was signed by Mr. James Day, Assistant to the Director of Radio Free Asia, and their address is given as 2 Pine St., San Francisco II, Cal., USA, of PO Box 3223, San Francisco.

ROYAL FUNERAL

THE value of short wave radio was indeed realised to the full on Friday, February 15, when by this means the many peoples of the British Commonwealth were enabled to hear the very impressive description of the funeral of his late Majesty. The BBC did a very good job and the quality and clarity of the broadcast was exceptionally good. We noticed quite a number of overseas stations relaying this program, one of the best being Radio New Zealand in the 31 metre band. There were quite a number of others but of course it was difficult to identify them all.

FLASHES FROM EVERYWHERE

NIGERIA. — There have been no reports for a long time now regarding the short wave station in Labos, Nigeria, which was heard out here a year or so ago on both 7.255 mc and 9.63 mc. According to a recent letter received by an American listener direct from the station, they stated they hoped to have a new transmitter on the air around the middle of last December and advised that it would be considerably higher power than the existing one. They asked him to forward any reports of reception as they were anxious to know the coverage. As the old station was heard out here, it should be possible to log this new one.

MADAGASCAR. — This French colony has always managed to put in a fairly good signal into Australia and has been heard for many years on one or other of their frequencies. From a recent session from Radio Australia we learn they use 9.695 and 7.375 mc for their Malgache programs and 9.515, 6.17, and 3.32 mc for French. Their schedule is (French) 1.30 pm to 3.30 pm, 7 pm to 9 pm, 1 am to 6 am weekdays and 2 pm to 5.45 pm, 6.30 pm to 9 pm, 1.30 am to 5.30 am Sunday; (Malgache) 1.30 pm to 3 pm, 6.30 pm to 8 pm, midnight to 3 am weekdays and 2.30 pm to 3 pm, 6.30 pm to 8.30 pm, and midnight to 3 am Sunday. An interval signal, musical notes played on a Malgache guitar, precedes the opening of programs on all frequencies.

ECUADOR. — The best-known of the Ecuador stations is undoubtedly HCJB, The Voice of the Andes, which has provided many listeners with their first South American station. At the present time, this station is using 12.455 mc and 17.89 mc both at the one time, though this is rather difficult to reconcile with their full schedule, which is as follows: 5.955, 12.455, and 15.115 mc from 9 pm to midnight, and 3 am to 3.30 pm. On 9.97 mc they operate between 9 pm and midnight, 3.30 am to 5.30 am, and 8.30 am to noon. 17.89 mc is used from 3 am to 8.30 am. Monday is a silent day for this station, which, of course, would be Tuesday out here, generally speaking.

EGYPT. — This country has been in the news of late and it is not often we hear anything about it, except in times of political unrest. Its short wave activities have never been very extensive, that is, as far as commercial program material is concerned, though they do transmit a lot of telegraphic traffic on various frequencies. Recently Cairo has been heard operating on both 9.555 mc and also 9.715 mc. On the former frequency, they broadcast in English at 6.20 am and 7 am, and in French at 6.25 am and 7.5 am. This station also uses 7.867 mc and 10.055 mc for their Arabic programs, but these we think are on Saturday only. Their address is Egyptian State Broadcasting, Broadcasting House, Cairo, Egypt.

VATICAN.—Many listeners have had difficulty in logging HVJ, the Vatican radio station, during their English transmissions, and the following notes from Radio Australia may be of help to them in this regard. English broadcasts are at present given on 9.646 mc, 11.74 mc and 15.12 mc at 1 am, while at 1.30 am there is another broadcast to India, Ceylon and South Africa on 11.74 mc and 17.84 mc. English can also be heard on 5.968 mc, 9.646 mc, and 11.74 mc at 4.15 am. There are also reports of HVJ being heard on 7.28 mc, though we have no record of them being heard in Australia on this frequency at any of the above times. The 5.968 mc channel is usually very good in Italian in the early mornings.

MISCELLANEOUS.—Radio Hollandis has moved from 7.125 mc to 7.17 mc; Suva, Fiji, is to have a new station, but it will not be in operation until 1953. The recent hurricane may have delayed it further; Mogadishu, in Italian Somaliland, is now using 7.383 mc and is on the air from 2.15 am to 4 am; the tests which were to have been carried out by the Apia station in Western Samoa will not now take place, according to advice from the station; Radio Algeria has been heard on 6.15 mc signing off at 9 am; Radio Pakistan has been using 6.235 mc and 7.01 mc to the British Isles from 6.15 am to 7 am; overseas reports say that OXI in Greenland has been heard opening at 8.45 am on 7.585 mc.

STATION ADDRESSES

YVOJ—Radio Universidad, Apartado 74, Merida, Venezuela.

YVOG—Radio Trujillo, Calle Independencia 200, Trujillo, Venezuela.

CXA13—Radio Carve, Sadrep Ltda., Mercedes 973, Montevideo, Uruguay.

CXA7—Radio Oriental, Olimar 1364, Montevideo, Uruguay.

OAX4P—La Voz del Centro del Peru, Apartado 187, Huancayo, Peru.

OAX4W — Radio America, Ocona 476, PO Box 1192, Lima, Peru.

ZPA4 — Radio Stentor, Independencia Nacional 703, Asuncion, Paraguay.

HC4EB — Radio Manta, Apartado 69, Manta, Equador.

HC5BL—Radio Alborado, Estacion Cultural, Casilla 1355, Cuenca, Equador.

HJCX—La Voz de Colombia, Apartado Postal 2665, Bogota, Colombia.

HJGB—Radio Santandar, Apartado 37, Bucaramanga, Colombia.

THE HAM BANDS WITH BILL MOORE

DX PROPAGATION CONDITIONS STILL ON DECLINE

During the last two years, amateurs have noted a gradual falling off in the number of distant stations they were able to contact due to changing ionospheric conditions. It is not anticipated there will be any change for the better for quite a number of years.

FOR those DX men, or for that matter any amateurs, who missed George Grammer's (WIDF) "Old Sol is the Villian" in QST, here are a few extracts so they, too, may shed a tear.

He points out that, although we may consider conditions poor on the 14 and 28 Mc bands compared with a few years ago; they are really all we can expect in view of the sun spot position.

There is, unfortunately, no relief in sight for a number of years, as the minimum in the sun spot cycle is not expected until 1954-55. The last minimum was in 1943-44 during the war, so we can't really judge how poor conditions will become, as we were not active during that period. Going back to the minimum beyond this in 1933, the 14 and 28 Mc bands were not then very well populated, so again we have no parallel by which to judge.

Broadly speaking, George states, it can be expected that the 10-metre band will pass out almost completely as a DX band, and that 20 metres will be about useless at night, except in the summer months. It will be worth concentrating on 7 and 3.5 Mc/s during the winter months for DX at night. The ionospheric prediction charts published monthly in Amateur Radio will be certain to tell us the sorry story here in Australia.

DEBATE ON BANDS

Operating facilities in the US are again coming up for review by the FCC. They have already agreed to the ARRL proposal, that the 75 and 20 metre telephony bands be opened for NBFM. Now they are considering as a result of several requests, changes in the operating arrangements for the 7 Mc band. The band is used exclusively for CW at the moment.

It has been suggested that frequency shift keying be permitted for radio printer operation between 7250 and 7300 kc/s, and secondly that 100 kc/s of the band be allocated for amplitude modulated radio telephony. The FCC set down a date in January for argument to be presented on these subjects.

The matter of a telephony allocation in the 7 Mc band has been the subject of debate over many years, and several ballots have been conducted on the idea by ARRL. Results of these have always been against telephony operation.

Commercial interference, especially from short wave B/C stations, is very pronounced on this band, and "W" stations not only have to compete with the stations that have crept into the exclusive amateur assignment, 7000-7200 Kc/s, but with stations operating from 7200-7300 Kc/s, which is a short wave broadcasting band except in the Americas.

Some years ago it was suggested that the latter segment be opened to the 1KW telephony stations and allow them to compete with the SW B/c stations.

News should be soon forthcoming on the results of deliberations at the Extraordinary Administrative Radio Conference held at Geneva late last year. The conference was sorting out frequency allocations through the HF bands.

The 21 Mc band was one under discussion and on present indications it won't be much good to us for DX working for quite a few years. Nearly 40 radio amateurs attended this conference in official capacities, representing their various Governments. There was a good DX roll up with the following prefixes:—W, DL, ZP, LU, HP, OK, OH, ET, VK, VE, YO, PK, ZL, G, VU, PY, PA, XE, AP, ZS and CX.

WIA CONVENTION—NSW DIVISION

The second annual convention of the NSW Division of the WIA was held at Federation House, Sydney, over the Australia Day weekend in January. The program arranged attracted a good attendance to all sessions.

Friday evening, the normal monthly meeting night, was devoted to a film show presented by Dave Duff, VK2EO and Stan Owen, VK2RX. 90 members and their wives enjoyed the entertainment.

On Saturday afternoon, as in previous years, a series of technical talks was presented by members. The session was opened by the president, John Moyle, VK2JU, and five lecturettes were delivered on various subjects.

Dr. Bob Black, VK2QZ, was first to the rostrum and he described the finer points of a finely-built 144 and 50 Mc receiver and transmitter. Bob, who recently resigned as president of the UHF section, knows all the points of UHF equipment.

Keith Rudkin, VK2DG, then displayed the receiver that was good enough to obtain him first place in the CW section of the Jubilee VK/ZL DX contest. Solidly and finely constructed, it was complete with Q multiplier and selectojet, plus all modern features. Keith, in describing the receiver, mentioned the only section not normally used was the noise limiter, as he never heard any at his location!

Dr. Leo McMahon, VK2AC, was the third lecturer, and he displayed and described the operation of an additive frequency meter. Using a 100 kc crystal and a VFO tuning from 100 to 150 kc/s, the instrument was accurate to few cycles. Leo, as has been seen from his contributions to Amateur Radio, is especially interested in frequency measurements.

John Miller, VK2ANF, well-known UHF enthusiast, then displayed a neat and unusually constructed 144 Mc transmitter capable of inputs up to 100 watts. It uses flat strip lines in the 829 final stage and a driver stage of an 832.

The final lecturer in the afternoon session was Bob Winch, VK2OA, who firstly described his 144 Mc mobile unit and, secondly, a simple capacity meter to be used in conjunction with a grid dip oscillator. Measuring from 1 MMF to 1 MF with an accuracy of better than 10 pc, the instrument was fully described in August, 1951, issue of Amateur Radio. The series of lecturettes were very interesting and showed what latent talent in the lecturing line was available among members.

During the evening session Bob Winch, VK2OA, was presented with a cup donated by the president, John Moyle, VK2JU, as his contribution during the afternoon was adjudged the most interesting.

90 members and guests assembled later in the evening for the annual dinner, with Mr. Allan Fairhall, MHR, VK2KB, as guest of honor.

After the usual toasts president John Moyle welcomed the visitors on behalf of the council and members and reviewed the activities of each in the radio or associated fields. He explained how they had assisted the division in presenting lectures, and spoke also of the co-operation offorded the WIA by the Wireless Branch.

Guests for the evening were Mr. Allan Fairhall, MHR, VK2KB, Dr. E. G. Bowen, Chief of the Radio-Physics Section of the CSIRO; Mr. John Briton, president of the IRE; Professor V. M. Bailey, of the Physics Dept., Sydney University; and Mr. T. Armstrong, Superintendent Wireless (NSW).

The president then listed the apologies and read a letter from Mr. Charles Moses, general manager of the ABC, who was chairman of the Arts committee of the Jubilee celebrations. Mr. Moses wrote in appreciation of the work done by the WIA in conducting the Jubilee VK/ZL DX contest and publicising Australia's Jubilee year. He complimented the Federal Contest committee, under the chairmanship of Wal Ryan, VK2TI, on the efficient running of the contest.

Mr. John Briton, president of the IRE, responded on behalf of the visitors, explaining the field in which each operated, and expressing appreciation on the progress of the Division.

TROPHIES

An important section of the evening was the presentation of the trophies won in the Jubilee VK/ZL DX contest by Mr. Alan Fairhall, MHR, VK2KB. Mr. Fairhall was closely associated with the original grant of £250 given for the running of the contest. He stated it had been difficult to decide which committee—Arts, Sport or Engineering, should have control of the contest—it was finally resolved that the Arts committee was suitable. Judging from the scores tallied up, perhaps there was more than a little art attached to it.

First place in the CW section of the contest was won by Keith Rudkin, VK2DG, who journeyed down from Lochinvar to receive a magnificent cup. Medallions for second and third place were won by Harold Whyte, VK2AHA, and Jim Cowan, VK2ZC, respectively. They were accepted on their behalf by Lionel Swain, VK2CS, president of the Hunter branch, who was very proud of the efforts of the members of the branch, who won all prizes in this section of the Australia-wide contest.

The cup in the telephony section was won by Keith Schleicher, VK4KS, and Harry Caldecott, VK2DA, a past Federal secretary, received the trophy on his behalf. Second prize winner was Harold Whyte, VK2AHA, and Lionel, VK2CS, again acted.

The Jubilee relay contest winner was Noel Colston, VK9XK, and Fred Stirk, VK2ABC, represented him, accepting the cup, while second place went to Tom Stroud, VK2AMR, of Dubbo, who was present to receive his medallion.

A NATIONAL ASSET

The toast of the WIA was proposed by the guest of honer, Allan Fairhall, MHR, VK2KB, an amateur and WIA member of some 25 years standing. In a forthright appraisement of amateur radio he pointed out that the hobby, as a national asset, in war or peace, should never be forgotten, and that through the WIA forceful claims should be made for additional privileges if they were desired.

He stressed, too, the value of personal contact with amateurs in all countries of the world, as a method of fostering international goodwill and pointed out how radio amateurs, in their own RAAF Wireless Reserve, were among the first called up at the outbreak of the last war.

With the formation of the Civil Defence organisation, Mr. Fairhall continued, amateurs would again be called upon to act in the national interest. Finally, he stated, that the WIA must be fully supported as the national body with which departments could effectively negotiate.

Past-president Ray Priddle, VK2RA, replied on behalf of the members, numbering over 800 in the State, and 2500 in the Commonwealth. He pointed out that the WIA was always willing to organise its members to assist in any crisis. Amateurs with the equipment they have available, and with the enthusiasm they

display in all their projects, could be called upon under all circumstances to assist.

The institute, however, must encourage younger men into the hobby and WIA, to ensure that the valuable work would always be carried on. Mr. Priddle expressed the opinion that the increasing of the age limit, from 16 to 18 years for the AOCP examination was a definite mistake.

Lionel Swain, VK2CS, president of the Hunter branch, supported the reply and spoke of his experiences of the value of amateurs in the Navy during the last war. He also said that he had personal experience of Mr. Fairhall's valuable work in executive positions in the Ministry of Munitions.

The lighter side of the evening was in the hands of Mr. Percy King, magician, ably assisted by Heather, Mrs. VK2FE, Peg, Mrs. VK2DY, VK2OF, VK2EL and VK2DY.

DX AND PERSONAL

MOST interesting contact on the UHF's during January was on 50 Mc/s and recorded between Hugh Lloyd, VK5BC, and Bill Scarborough, ZK2AA, on Niue Island, over a distance of 3500 miles. Bill's trip to the US paid dividends for the UHF gang when he arrived back with 50 Mc gear. He was DX guest of honor at the Seattle 1951 ARRL National Convention.

Those who read of Captain Carlsen, of the Flying Enterprise, working his small transmitter from the disabled vissel, will be interested to learn he is a radio amateur. Back home in New Jersey he signs W2ZXM. The information came through in a round about way—Johnny Clarke, VK2DZ, has a sister in London, who attended a civic reception to the captain, and passed the news along.

New sub-editor for Amateur Radio in NSW is Harry Powell, VK2AYP, who would be pleased to hear from anyone with bright ideas or articles for the magazine.

Since the G's lost their 56 Mc band to television, the UHF group have been concentrating on 144 and 420 Mc/s.

On the latter band in recent tests conducted by the RSGB, eight contacts over 70 miles were made in a weekend. The greatest distance covered was 110 miles, most of the contacts being made on CW.

Some novel gear for the tests was constructed; G6VX's receiver is worth mentioning. To eliminate feeder losses, high at the frequency, the input portion of the receiver was located in the centre of a 16-element array. A push-pull crystal mixer and 25 Mc IF were at the antenna, and the output of the latter was fed through a 100ft coaxial line to a 640 receiver. Another 100ft coaxial line permitting the output of a tunable oscillator to be fed to the crystal diodes.

Morrie Myers, VK2VN, who returned from the US late last year, reported that much amateur equipment was in short supply due to the changing over of most factories to the production of war equipment. To overcome some of the problems, the National Production Authority have issued a priority up to the value of 100 dollars to all amateur stations to allow them to procure scarce materials.

To encourage amateurs to join the various National Services—defence and security—the allotment has been doubled and priorities to the value of 200 dollars are available to members of National Emergency Net System (ARRL), Radio Amateurs' Civil Defence Service, &c.

NORTH COAST

All arrangements are now complete for the Easter Convention on the North Coast, NSW. Organiser Crieff Rettalick, VK2XO, desires that several points be given further publicity.

One operator only is permitted in the G. Challender Remembrance Trophy Contest, but any number may be used in the Urunga Scramble Contest.

The location for the 144 Mc hidden transmitter has been selected, and for those building equipment it might be noted that cars can be driven right to the spot. Your equipment used in the search need not be readily transportable. The spot has been selected with great care, and it's exact location, it is hoped, will keep this gang guessing for quite a period.

Accommodation is still available at the time of writing, and if you intend bedding down in the various huts, bring blankets, &c.

Final arrangements can be checked with zone officer Noel Hanson, VK2AHH, of West Kempsey, or Crieff Rettalick, VK2XO, of Raleigh.

ACCURATE SIGNALS

The Victorian division of the WIA are again running accurate frequency transmissions this year. First transmission in 1952 was scheduled for February 28 with check points to be given on the 7mc band. Initial announcement will be at 2105 hrs. EAST on telephony on the normal WIA frequency, 7196 kc/s, and general information will be given on the schedules.

At 2115 hrs. a marker transmission will be given on 7000 kc/s, then on 7010 kc/s, 7030 kc/s, and at 20 kc intervals.

RUSSIAN "HAMS"

A few Russians seem to have made a reappearance after an absence of some months. New prefixes seem to be in use and they are certainly not active in the same numbers. No QSL cards have been received from their QSL Bureau, Box 88, Moscow, since the middle of last year. It would appear that we can write off 16 countries from our countries' list and the future of the "Worked All Zones" Certificate is in doubt.

YOUR OPPORTUNITY

to join the world-wide ranks of amateur transmitters! The Wireless Institute of Australia holds regular classes in Sydney to assist Sydney and suburban enthusiasts to obtain their Amateur Operators Certificates of Proficiency.

Write for particulars to the Class Manager, W.I.A., Box 1734, G.P.O., Sydney.

SMALL CRAFT PRISMATIC HAND BEARING COMPASS

IDEAL FOR FISHING BOATS

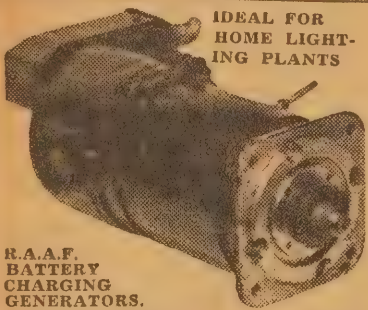
£8/15/-

This Compass is designed for small craft in which the steering compass is not placed for taking bearings.

ENGLISH BOXWOOD CALIPER GAUGE

MAKES IDEAL ROPE GAUGE

Many uses — for Carpenters Engineers, Hobbyists. 8/9 8/9



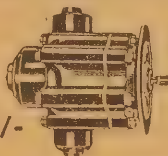
IDEAL FOR HOME LIGHTING PLANTS

R.A.A.F. BATTERY CHARGING GENERATORS.
24 volt, 1500 watt £15/15/-
Brand New English Lucas, 12 volt or 24 volt, 500 watt £10/15/-
Brand New 24 volt, 1000 watt .. £13/13/-

American Vacuum or Air Pump.

Builds up air pressure to 30lb. at 1000 R.P.M. Develops up to 120lb. of hydraulic pressure, will pump 7½ gallons S.A.E. oil or other liquids per minute. Useful for spraying, milking, presses, oil burners, hydraulic systems £3/15/-

BRAND NEW HYDRAULIC PUMPS. 1000lbs. per sq. in.

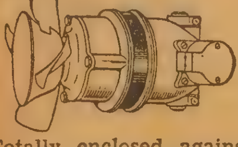


Cost £39/10/-

Our Price £7/10/-

Useful for tractors, hoists, presses, etc.

LARGE 12-VOLT AC-DC MOTOR AND BLOWER



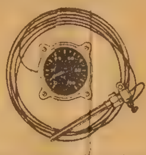
FIT ONE TO YOUR CAR.

£4/10/-

Totally enclosed against fumes or salt water.

Gents' chrome plated wristlet watches fitted with chrome expanding band £4/4/-. Brand new sports binoculars, screw focusing 35/- pair. French motor cycle goggles fitted with sun visor 16/6 pair.

BRAND NEW REMOTE CONTROL TEMPERATURE GAUGES.



35/-

Ideal for cars, tractors, boats, ovens, etc. Never before at this price.

COMPLETE BATTERY CHARGER

Fitted with brand new English Selenium Rectifier.

Works off 230v. A.C. Household Supply.

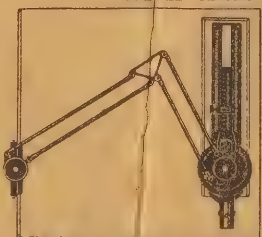
Charges any battery from 2 to 6 volts at 5 amps. £6/15/- complete.

Brand New Head-band Type Magnifiers

Made in England
Optically ground Lenses.
49/6

Ideal for instrument makers, watchmakers, tool makers, medical work, chemists, etc.

R.A.F. PLOTTING BOARD WITH ARM



Bakelite Base. Draws Angles Parallel or Vertical.

70/-

IDEAL FOR ENGINEERS, STUDENTS, ETC.

SPECIAL DISPOSALS METER OFFER

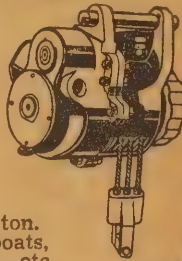
0-1 milliamps, 2½" dial .. 37/6
American Weston 0-50 voltmeters .. 42/-
Weston 0-50 volt 0-100 amps combined .. £3/10/
English 50-0-50 Ammeters .. 32/6
English 20-0-20 Ammeters .. 27/6
English 0-20 Voltmeters 25/-
Eng. 0-300 AC-DC Voltmeters 47/6
Eng. 0-5 Milliammeters 2½ .. 27/6
Eng. 0-150 Milliammeters 2½" 30/-

Ball and socket inspection mirrors, 8/6. Ideal for engineers. Car dimmer switches, 12/6. Bakelite 3 draw telescopes, 15/-. 300 watt vernier variable resistors. £4/15/-. 2 negative and one pos. projection lenses, 25/- set. Brand new vernier calipers fitted with depth gauge, 25/-.

SURPLUS

512 ELIZABETH ST., MELBOURNE, C.1.
PHONE: FJ5904. JUST 4 DOORS FROM
ALL PRICES SUBJECT TO

R.A.F. BOMB HOISTS 175 TO 1 GEARING. WORM DRIVEN. CAN BE HAND OPERATED OR MOTOR DRIVEN.



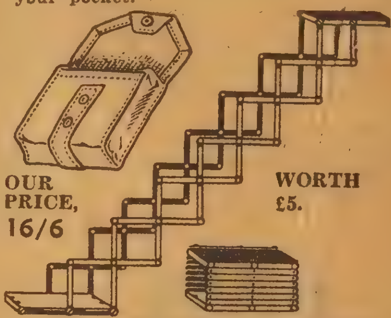
Fitted with quick release clutch.

Cost £35.
Our price
£6/19/6

Will lift ¾ ton. Ideal for boats, garage work, etc.

GENUINE ARMY PERISCOPES

Remember, there is going to be a Royal visit soon. See over any crowd. Fits in your pocket!



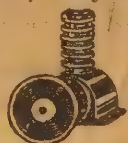
OUR PRICE, 16/6

WORTH £5.

Engineers' Calipers, 4" Special Dividers Outsize and inside Calipers, each Screw Screw 5/6

BRAND NEW AIR COMPRESSOR

2.2 cubic feet, will pump up to 75lb.



Never before at this price

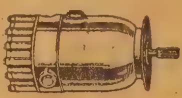
£11/15/-

Will work off ¼hp motor.

Ideal for spraying.

BRAND NEW EXTRA LARGE

Exceptional quality hydraulic pumps.



1200 lb. per sq. in.

8 1/3 gal. per minute

Ideal for all hydraulic uses.
Cost £100. OUR PRICE. £18/18/-.

SURPLUS STORES

PLEASE ADD FREIGHT OR POSTAGE
Mail Orders Carefully Packed
ALL PRICES SUBJECT TO

STORES

512 ELIZABETH ST., MELBOURNE, C.I.
VICTORIA STREET. Phone: FJ5904.
ALTERATION WITHOUT NOTICE.

Genuine English RAF Mk. 8 Flying Goggles Brand New, 48/6.

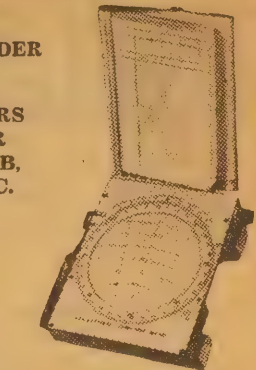
Genuine English RAF Flying Helmets, 35/-.

Speaking Tubes to fit above helmets, 50/-.

King Dick Metric Ring Spanners 4 to set, 47/6. Extra Long Nose Pliers, English make, 9/6 pair.

IN FIRST CLASS ORDER

DALTON COMPUTORS IDEAL FOR AERO CLUB, A.T.C., ETC.



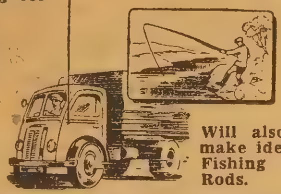
Only Limited Stocks Available. Be Early.

45/-

STEEL ARMY TANK AERIAL RODS WILL MAKE IDEAL RADIO AERIALS FOR CAR OR TRUCKS.

Too long for postage, advise nearest Railway Station.

Base to suit Aerial.



8/6

Will also make ideal Fishing Rods.

12ft long. 3 sections. Each section 4ft. 25/-. 8ft long. 2 sections 15/-.

ENGLISH ARMY SPOTLIGHTS

IDEAL FOR SHOOTING

FIT ONE TO YOUR CAR.

6-volt, 37/6. 12-volt 25/-. Fitted with Mirror Reflector

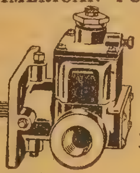
ARMY GARAGE OR BENCH LAMP

£3/10/-

Made for 6-12 or 28 volt globes. Ideal in the workshop.

ROTARY AMERICAN PUMP

USED BY THE R.A.F.



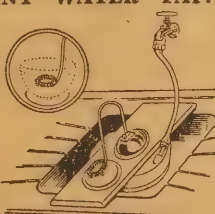
STAINLESS STEEL VANES

WILL PUMP ANY LIQUID

400 galls per hour 55/-

BE EARLY FOR THESE WATER DRIVEN CAKE MIXERS; WORK OFF ANY WATER TAP.

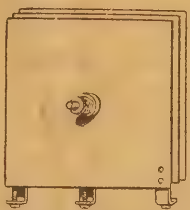
Brand new Ideal for Country Users. Will fit any sink. Why pay for an expensive mixer?



ONLY 39/6

BRAND NEW ENGLISH RECTIFIERS

Make yourself a Battery Charger.

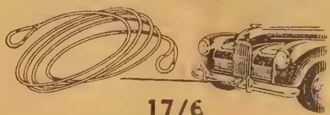


12v	2 amp	30/-
6v	5 amp	39/6
12v	5 amp	65/-

ARMY FOCUSING TELESCOPE. Easily converted for use on dumpy levels.

Can be used as a rifle sight. Excellent magnification. £4/19/6.

AT LAST! AT LAST! ARMY STEEL TOW ROPES. Complete with looped end.



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WATCHMAKERS AND INSTRUMENT MAKERS

14/9

English Tweezers	5/6
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Eyeglasses	6/6 and 8/6
Extra Strong double lens Eyeglass	15/-
Small Screw Drivers, 2/6. Large,	3/6.

ENGLISH MOTOR AND BLOWER, 24 VOLTS

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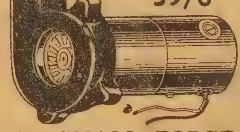
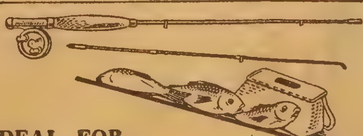
Will Work off 32-volt Lighting Plants.



IDEAL FOR SMALL FORGE.



IDEAL FOR THE HOLIDAYS

2-Piece Steel Fishing Rod .. 15/6
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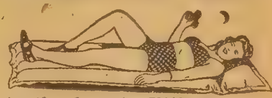
LUCKY PURCHASE OF INFLATABLE RUBBER AIR BEDS

Ideal for Caravans, Cars, etc. Ideal for Hikers.



Take one to the beach. Will float in water. £4/15/-.

CELLULOSE ACETATE SHEET

takes the place of celluloid. Will not discolor, non-inflamable, replace those broken side curtains. Can be sewn or cemented into frames 24 x 52. 20 thousandths of inch thick. Sheet 32/6

SPECIAL OFFERS

Army despatch rider's goggles 9/6 pr. English car parking lamps 15/- or 27/6 pr. Brand new telescopic car radio aerials 8ft. 6in. long, fold down to 13½" 59/6. DPOT Aerial change-over relays, ideal for transmitters 22/6. 3½" parabolic reflector mirrors 15/-. 10½" 39/6. Build yourself a spotlight or useful for photographic work. Dental handpieces, useful for engraving, 25/-.
English interchangeable blade surgical scalpel, handle and 3 blades, 10/6. Ideal for hobbyist.
Frogman swimming fins 45/- pair.
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English 4 Draw Rifle Range Telescopes, 22 magnification. Open out to 17¼" length £6/19/6
Commando Pocket Telescopes 39/6
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English Low Pressure Spray Guns. Work off 35lb £3/15/-
Army Folding Bolt Cutters .. 15/-
Brand New English Headphones, 17/6 pair. American Feeler Gauges, 8/6

12-volt Generators, 250-volt output at 125 mils; perfect B. supply for any radio or amplifier from 12-volt accumulator, £4/15/-.
Hard to get Truck and Tractor Ring Spanners. King Dick 1 1/16" x 1⅛" 35/-. 1 1/16" x 1¼" 37/6.
Half Moon Ring Spanners ¼" x 3/16" Whit. 10/6. ¼" x 5/16" Whit. 12/6.

5/8" x 9/16" S.A.E. 12/6. ½" x 7/16" S.A.E. 9/6. King Dick S.A.E. Ring Spanner Sets, 6 sizes 39/6.
Shaded pole induction motors made by Hoover of England, 230 volts A.C. Constant speed 1200 r.p.m. Very silent running. Ideal for cine projectors, grammo motors, hobbyists, instrument makers, etc., £4/19/6.

Electric Soldering Irons, work off 12 or 24 volts. Ideal for lighting plants, or will work off your car. Battery, 35/- each.

Telephone FJ5904

INCLUDE STATE IN ADDRESS
and Efficiently Despatched
ALTERATION WITHOUT NOTICE

Large size air compressors 8.5 cubic feet 150 lbs pressure. Ideal for garage work, spraying, etc. £39/10/-.

OFF THE RECORD — NEWS & REVIEWS

EMI have announced that they will soon be recording the Sydney Symphony Orchestra conducted by Eugene Goossens in a number of works including several symphonies. The making of these records will probably constitute a landmark in the history of Australian recorded music.

By JOHN MOYLE

THESE won't be the first records made of the Sydney Orchestra. Last year we had a recording of Corroboree, by John Antill, under the leadership of Goossens. Earlier, EMI had made a number of orchestral records—one quite good effort featuring pianist Lindley Evans and Frank Hutchens in a composition by the former. Some recordings go back even further than this.

The importance of the new venture lies in the fact that EMI expect to make the projected recordings available in their main catalogue, which will give them world-wide sale. Although many hoped that this would have been done with the Corroboree records, I do not think they were on sale outside Australia.

That EMI is taking these plans seriously is shown by the visit of Mr. Arthur Clarke, veteran recordist of the company, to supervise the work.

Mr. Clarke should have many interesting things to say during his visit, for he has been making records for the company and initially for HMV since 1907.

That goes back into the pioneer days when the bright stars of the musical world were becoming interested in the new musical medium. Harry Lauder, John McCormack and Peter Dawson are probably the most famous names dating from those times, not forgetting, of course, Dame Nellie Melba, who made some of the earliest celebrity records. Chaliapin is another name linked with the early years, although Peter Dawson has outlived them all, and still makes an occasional disc. I'm sure many of my readers remember such efforts as the Floral Dance and his famous aria from the Barber of Seville.

Mr. Clarke is also credited with the design of some of HMV's earliest gravity-driven recording machines, later developments of which are still used at Hayes.

His presence here will undoubtedly mean a great deal to the Homebush recording studios, whose staff, I feel sure, will be looking forward to his help and general stimulus.

THE ORCHESTRA

There are many other implications tied in with the project which should give us cause for optimism, not the least of which is the knowledge that EMI is willing to accept the Sydney Orchestra as having reached a standard high enough to compete with other more famous orchestras in the world.

Sydney's chance might be related to the fact that many consider British orchestras are not at present as good as they have been in the past. If this is so, EMI are very wise in exploring other talent, particularly in Australia, which undoubtedly will grow in importance as a centre, not only musically but industrially.

It has been said that one reason for the Philadelphia Orchestra's rise to fame was its proximity to the recording studios, and the fact that it was nearly always available. I feel sure that, provided the Sydney Orchestra's records are a success, the same principle could easily apply.

More than this—if the records are favorably received overseas, there could be no greater encouragement to other famous conductors to make the trip out here.

ADDS UP

The effect of all this would be cumulative. If the records earn money for the orchestra, this will help it to raise its standard. A few issues of good quality under well-known conductors will be the best advertisement the orchestra could have.

There is no doubt that Australia should always be able to support at least one orchestra of world class. Success with Sydney's efforts will make it easier for a second orchestra to follow its footsteps. For the moment, we should regard the Sydney combination as first of all an Australian spearhead. There should

be no element of rivalry in a poor sense because it happens that Sydney's orchestra is the first to make the grade for various reasons. Eventually the whole orchestral picture will benefit, assuming that this opportunity is successful.

In all this, we should remember that the presence of Goossens in Australia as the orchestra's conductor probably played a major part in the venture. After all, EMI cannot be expected to take a recording risk out of the goodness of their hearts. Goossens' name is well known on records—he has recorded with many orchestras all over the world.

Without his name on the label—and, for that matter, his work with the players—EMI might not have considered taking the chance. We might have been glad to see at least one Australian who has done so much for our music represented in the series of records. At the moment, however, we must appreciate the recording company's point of view.

MATTER OF SPEED

In passing, we might note with some legitimate regret that it is unlikely that the records will be made at any speed other than 78.

The original will probably be made on tape, so that it could be issued at any speed. But there is still no hint from EMI that their policy has changed concerning long players.

EMI has been wise to make a start with the Sydney Orchestra, as it is inevitable that, from now on, other recording companies—including new local ventures—will be planning to make and release Australian-made records of good music played by Australians.

I am quite sure that in the realm of instrumental music, at any rate, we can turn on some fine performances out here, even if the position isn't as hopeful in the vocal sphere.

Not that success by EMI will discourage such ventures. On the contrary, it might well stimulate it. Maybe I am looking a little way past the immediate future in saying this, but I do consider it quite inevitable that locally-made records at various speeds will sooner or later appear in increasing numbers just as they have elsewhere. The effect of this on our musical future may well be profound.

I have heard disappointment expressed that the programe as announced contains comparatively well-worn music, such as the Beethoven Second Symphony, Mendelssohn's Scotch Symphony and other smaller pieces. I don't altogether agree that this is a wrong policy, and I'm quite sure that EMI haven't selected the program without plenty of thought.

CHOICE OF ITEMS

I think it essential to make sure that these records have every chance to sell well, and that won't happen unless they include numbers which are universal favorites. I would say that the list contains quite a representative selection from a record sales point of view. Why not take a bold policy of finding out whether Sydney's Beethoven Second will sell well against established competition? That is certainly one of the things EMI will want to know when considering whether they will persevere with the orchestra. To make a best-seller of lesser-known music, or music having a more specialised appeal, might well call for more guns than can be at present mustered by the project as a whole.

In other words, this is a commercial venture in the first instance, and EMI must be considered the judges of what part of the orchestra's repertoire will be used for its initial world-wide bow.

It will be highly interesting to see how various technical problems are solved. For instance, there is no really suitable recording hall easily available in Sydney at the present time. The Ashfield Town Hall has been used in the past, but it is at best only a makeshift. It will be necessary to do a great deal better than this. Neither orchestra, conductor, nor sound engineers enjoyed their last experience of this hall, to say nothing of the impossibility of completely damping out traffic and other noises. If any extension of the initial recording program is to take place in the future, this is one problem which must be solved.

I wish all concerned the very best of luck with this venture. I think it completely essential that it should succeed in the interests of Australia's recording future. There is no doubt that we can build one if we try.

HOW HOT SHOULD A VALVE BECOME?

THE progressive reduction in the size of radio valves has indirectly been responsible for the impression that modern miniatures are subject to overheating. Such is not the case.

Of the very old and very large valves—like the 47 and 80—few ever became more than uncomfortably warm in service. This was due in part to the poor conduction of internal heat to the glass and the large surface area over which the heat was dissipated.

Reducing the size of the glass envelope, as for valves like the newer 80, the 42 and such like, reduced the spacing to the glass and the surface area available for radiation. The glass, therefore, felt appreciably hotter, even though the temperature of the internal elements may not have been greatly affected.

The still smaller—"GT"—series, particularly valves like the 6V6-GT and 5Y3-GT, operate with a glass temperature far too hot to touch. Metal valves, which are of about the same dimensions often operate with the shell at "sizzling" heat. The fact is that internal heat is being radiated so effectively from the shell that the elements inside might conceivably be cooler than in a glass bulb.

Most of the modern miniature AC valves also become so hot after a period of operation that they cannot be handled, the exceptions being where the valve is well ventilated, and not handling much power in the plate circuit. Miniature rectifiers and power valves run at the highest bulb temperatures because they normally employ high wattage heaters and dissipate many watts in the plate circuit.

FROM THE SERVICEMAN WHO TELLS

(Continued from Page 69)

when we first got it," at the same time indicating where he considered the volume control should be. Considering the type of pickup, it did seem unreasonable that the control had to be advanced so far, while I fancied I could still detect some distortion.

At the same time I was not very happy about the second section of the twin electrolytic unit.

Tracing the wiring established that this section was used as a decoupling by-pass for the HT to the two 6SJ7's, and a finger gingerly applied to the decoupling resistor confirmed my suspicions, for it was also quite hot. Observing the voltage when the electrolytic was disconnected established the point beyond all doubt and I fitted a new condenser and tried the performance again.

There was no doubt about the sensitivity now or, for that matter, the estimate by the operator as to where the volume control should be set, for a satisfactory volume was now available with it set as he had indicated.

It was not hard to visualise the operating conditions as they had been. Not only had one section of the electrolytic reduced the voltage to the screens of the 807's, with resultant low output, but it had also reduced the plate and screen voltage to the early amplifier valves. This voltage had been further reduced by the second faulty electrolytic in the decoupling circuit.

And this little story may make you chuckle or serve as a warning, depending on your technical status.

A customer I know fairly well, while having a couple of valves checked, had raised the subject of microgroove recordings. "Are they as good as they are cracked up to be?" he asked. I replied that I thought they were, and that they were certainly a considerable improvement on the best standard recordings. Then I asked if he were thinking of buying any. (After all, business is business.)

"Well, not exactly," he replied. "I was enquiring more on behalf of a friend. You see, the turntable in my radiogram has no speed control so I can't slow it down, but my friend's has, and he was thinking of slowing it down and buying some microgrooves."

"And what else?" I enquired.

"Oh, nothing else," he replied then, as suspicion dawned upon him "do you need anything else?"

I spent the next few minutes explaining that (1) a turntable needs more than a speed control to allow it to run satisfactorily at the required speed, it being impossible to obtain sufficient power when it is slowed down with the governor and that (2) the pickup intended for standard recordings is much too heavy, and has too large a needle point for the delicate grooves of the new recordings. I had visions of a choice microgroove, worth something in the vicinity of £3, being played (or ploughed) with an oversize steel needle in a rock crusher pickup weighing several ounces instead of the recommended quarter ounce.

It makes yer shudder, don't it?

BETTER THAN SOAP

(Continued from Page 17).

The mechanism by which the quartenaries attack germs is unlike other germicides. It would appear that they really dissolve bacteria.

Bacteria contain organic nitrogen and phosphorous compounds which are normally retained within the cell when it dies.

With the use of quartenaries these compounds are actually released and it is assumed that the cell is actually broken up.

These substances also improve the fastness of the dyes in colored fabrics. They render the material soft and smooth and a new process uses them in waterproofing fabrics.

When the solution is applied to the fabric, dried and heated, the quartenary decomposes and reacts with the cellulose of the cotton to give a permanent waterproof finish.

These substances are indeed remarkable for their versatility and will go a long way to simplifying some of the processes of industry.

ANSWERS TO CORRESPONDENTS

G.W.P. (Toowong, Q) raises a point about the championship model plane described in the Hobby Handbook, being worried about the risk of breaking the propeller when landing.

A.: There is no guarantee that the propeller will not be vertical when the plane lands, and the risk of breakage appears to be one which model plane enthusiasts are willing to take. The fact that the propeller is free to revolve and, in fact, would be revolving, when the plane was landing would help to reduce the risk, as it most likely that even if it struck the ground it would be pushed to one side.

A.D.M. (Dyers Crossing, NSW) wants to know if we can arrange to have the Heavy Duty Battery Charger built for him.

A.: Sorry A.D.M. (and others) but this is something quite out of our line, and we can only suggest that you contact some of our advertisers, particularly those handling kit sets, and a request that they supply the parts and have the unit built for you. However, we do not think there are many firms who undertake this work, and as it is not a very complicated circuit you may care to tackle the job yourself. It is designed to operate from a standard 240 volts AC power point.

N.R. (Melbourne, Vic.) forwards a circuit of a double conversion superhet and wants to know what are the chances of it working.

A.: While the double conversion part of the set appears to follow standard practice in this regard the circuit is rather unconventional in that it does not use any IF amplification, signals being taken straight from the second converter stage to a leaky grid detector. The use of regeneration, as provided, will help in part, but the real advantage offered by the 175 Kc channel ie, ability to amplify without instability, is largely being lost. It is most likely that the set will work although it is doubtful whether the best use is being made of three valves.

B.E.W. (West Preston, Vic.) is keen to build the "Reinartz Two," featured in the August, 1951, issue of Radio and Hobbies, and wants to know if we think it would be too difficult for him, considering this is his first attempt.

A.: It's rather difficult to say B.E.W., you see, we haven't a very complete picture of your ability in this regard. Some chaps just take to a set like this like a duck to water, while others can get themselves into more strife than one would believe possible. The series "Learn While You Build" was originally intended for fellows like yourself, but the set you have selected is one of the more advanced developments which had been built up, a little at a time, over several months. It would be much easier, therefore, if you had been able to start at the beginning and approach the subject slowly, or even if you could obtain a copy of the previous (July issue) which contained a detailed explanation of the first half of the August circuit. Unfortunately this copy is no longer available from this office, but you may be able to borrow a copy or we can supply circuits and parts lists, &c. Against all this, we know of several chaps who have successfully tackled sets as big, or bigger, at their first attempt with 100% satisfaction, but we are afraid that the final decision is up to you.

W.H.W. (Invercargill, NZ) complains that he did not receive the May, June and July issues apparently as the result of a local industrial dispute. He wants to know whether these are available and also asks several other questions.

A. The circumstances in New Zealand which prevented you from obtaining the copies were entirely beyond our control and all the surplus copies were absorbed on the Australian market. The popularity of the Learn While You Build It series had a lot to do with this. We checked with our publishing department about the release dates at the moment but they say that these are largely determined by shipping dates, &c. Glad to see you continuing interest in Radio & Hobbies and we have passed your par on to the Serviceman for his attention.

C.W.F. (South Brisbane, Q.) wants to know if it is possible to obtain an index for volume 12 or whether one is to be published in the near future.

A. Unfortunately this is something that has had to be omitted due to shortage of both space and time, the latter particularly, since it requires many manhours to compile such a list.

M.H. (Lameroo, SA) asks us to send him a copy of the Shortwave Handbook for 1950, and wants to know if we have yet published Hobby Handbook No. 2.

A. We have posted a Shortwave Handbook to you M.H., and you should have received it by now. There has been only one Hobby Handbook published, and at the moment, we have no plans for further editions.

A.S. (Werribee, Vic.) sends along a repair hint which he says helped him out when he was in a spot.

A. Thanks, A.S., we will hold the letter in case we can include the idea with some general comments in some issue. You will agree, of course, that the repair is in the nature of a temporary measure only and that its success or otherwise depends to a great extent upon the circumstances under which the component is used.

R.R. (Foster, Vic.) sends 12 months subscription and also a circuit of a simple signal tracer which he recently constructed from odd parts in the junk box. He also describes how he built a multimeter around a disposals O-1 mA. meter.

A. Many thanks for your subscription R.R. which has been forwarded to the appropriate department. Your description of the signal tracer has been filed for possible future use in the "Reader Built It" section. You were very fortunate in being able to construct a multimeter around such a low price instrument and as you say, this would hav been made somewhat easier by havin the use of bridges, &c. Without suc facilities metres of unknown charac teristics present some difficult problems

P.T. (Singapore) has found that i many cases the earth lead can be use as an effective aerial and wants t know if this causes any harm to th set, disturbance to other sets, or is i any other way harmful.

This is quite a common effect P.T and is often due to the presence of RJ signals in the power mains and hous wiring. In general no harm will re sult to your set or other sets, but w would advise very strongly agains operating AC/DC sets in any way othe than that intended by the maker a there are many circumstances wher dangerous conditions can be created.

O.A. (Manly, NSW) wants to know i it is possible to fit a pickup to th Superhet Four.

A. We have had several requests alon these lines O.A. and tests seem to in dicate that there is enough gain t enable a high output crystal pickup t be used. This can be fed straight int the grid circuit of the 6V6, the couplin condenser to the diode circuit bein disconnected. We hope to prepare som more details along these lines and, i possible to include them elsewhere i this issue.

J.M. (Melbourne, Vic.) wants to know if he can purchase a circuit diagram o the 1952 Radiogram.

A. Yes, J.M., but we doubt whether thi is what you really require. The circui diagram has already been publishe in the magazine and, as it is this whic appears to be causing you bother, w suggest that you are really after wiring diagram. If so we regret w cannot help you. If we had prepare such a diagram we would most cer tainly have published it, for such draw ings take many days to prepare, whic is also the reason we are unable to pro vide them for the larger projects. I any case, sets of this size are hardl suitable for beginners and we sugges you tackle something a little less com plicated for a start.

NEW ARRANGEMENTS FOR QUERY SERVICE

RISING costs and increasing correspondence have made it necessary to revise the conditions governing our postal query service.

In future, all queries concerning "R & H" designs, to which a POSTAL REPLY is required, must be accompanied by a postal note or stamps to the value of TWO SHILLINGS.

For the same fee, we will give advice by mail on radio matters, provided the information can be drawn from general knowledge. UNDER NO CIRCUMSTANCES, however, can we undertake to answer problems involving special research, modification to commercial equipment or the preparation of special circuits.

Whatever the subject matter, we must work on the principle that a letter is too involved if the reply takes more than 10 minutes of our time.

Queries not accompanied by the necessary fee will be answered FREE in the columns of the magazine and presented in such a way as to be of interest to other readers.

To those requiring only circuit reprints, &c., we will supply for TWO SHILLINGS diagrams and parts lists from our files covering up to three "R & H" constructional projects. Scale blueprints showing the position of all holes and cutouts in standard chassis will now be 3/6. These are available for nearly all our designs.

Address your letters to The Technical Editor, "RADIO and HOBBIES," Box 2728C, GPO, Sydney.

Note that "RADIO & HOBBIES" does not deal in radio components. Price quotations and details of merchandise must be obtained direct from our advertisers.

Readers say:

THREE STATES!

As you suggested, I tackled the Basic Xtal Set, and later the Amplified Xtal Set, and with the latter, using full volume, can bring in 3AR, 4QG, 2CA and 2NZ at reasonable strength. (Coils were enlarged, slightly).

Now I want to go further. Unfortunately, we have no power here so, practically, the present series of "Learn While You Build" is not much good to me. May I say, however, that those responsible for these articles deserve full credit for some excellent theory and I should expect, for well planned practical work for those who can use it. —M.M. Lue, NSW.

A BOUQUET

I am writing these few words to tell you how much I like your Radio and Hobbies. I have been getting it since 1939 and I think it's the best radio book in Australia. The Short Wave section has been a great help to me as I've been listening in on the short waves for many years, both CW and voice, and always on the look out for new stations. Mr. Ray Simpson does a good job.

All of the radio receivers I have constructed are out of Radio and Hobbies and I am pleased to say they have all been a success. Your book is worth double the price it is now. I like the "Reader Built It" section very much, have tried out a few of the novelty circuits with quite good results. —C.G. (Coburg, Melbourne).

LIKES OUR ARTICLES

Since 1944—when I arrived in Australia—I have read many of your issues (sometimes I had a subscription, sometimes not, depending on my activities in the electronic field) and many a time admired the way circuits and their building up were described On certain pieces of equipment—whether receivers, amplifiers or instruments—I sometimes had a different opinion (too many roads lead to Rome), but invariably ended up absorbing many a constructional point from your ideas.

Being a design engineer (mechanical) myself, I always take to the neat blueprints, which are a joy to look at.

Also I like the section "Let's Buy An Argument" because problems are discussed in a slightly higher technical level.

The articles in popular science, spreading a wide field, are often very interesting and invariably absorbing to read.

I write these ideas to you not for trying to be nice, but because they should be said as the only form of contact and appreciation there can exist between editor and reader, and also and more so because I do often come across "technical men in the radio field" who would like to see more formulae, graphs, &c, more of the "real stuff." I only wonder what they would say when all that additional (backroom boy) calculation was pushed under their noses.

CIRCUITS FOR PHOTOTUBES

(Continued from Page 55)

blades, wire, tube stock, and many other materials.

A good example is its use in making precision measurements on piston rings. One light beam, directed at a phototube, scans the separation of the sample ring and a master. If the sample exceeds the permitted tolerance, a rejection signal is operated. A mechanical shutter cuts off this beam as the piston ring gap is scanned. A second beam, scanning the gap, causes other rejection signals if the gap dimension is under or over tolerances. The entire inspection cycle requires less than five seconds.

The selenium cell is the most common photoconductive cell in modern usage. It is usually mounted in a glass container filled with an inert gas. Although used in conjunction with an amplifier in some cases, the photoconductive cell will pass sufficient current to operate a very sensitive relay directly. A relay having a winding resistance of 5000 to 10,000 ohms is frequently used in connection with these cells.

When an amplifier is used with photoconductive cells, the choice of the grid resistance should depend upon the light resistance of the particular cell used, rather than being as high as possible, as with phototubes.

Fig. 7 illustrates the novel use of a self-generating selenium cell with a 1N34 germanium crystal rectifier to operate a rugged, less expensive relay. A small DC operating bias is provided by the crystal rectifier operated from the 6.3 volt winding of the filament transformer. This circuit is applicable to a wide variety of devices such as intrusion alarms, light-operated switches, garage door openers, &c.

It is also used frequently in crowd-attracting window displays, because of its simplicity, and the fact that the absence of a high gain amplifier makes it immune to false operation by extraneous signals.

Photovoltaic cells are most frequently used directly in series with a relay, meter, or other load. See Fig. 8. A simple photovoltaic cell consists of a lead electrode and an oxidised copper electrode immersed in an electrolyte. Exposure to light causes the cell to become a generator. Other "dry" photovoltaic cells consist of a sandwich of iron and selenium fitted with copper electrodes.

Since such cells generate an emf, they require no external source of power.

The copper oxide type of cell (Photox) has a color response almost identical with that of the human eye and hence is used in illumination control and in regulating industrial processes in which color or change of color of the product are important.

LET'S BUY AN ARGUMENT

(Continued from Page 73)

happen to look better or to look worse in your own listening room.

But where does all this general talk get one? Must every listener be a part-time acoustic engineer as well? Or should Radio and Hobbies pioneer a standardised living room? The Editor's "Playmaster" room for his "Playmaster" amplifiers?

I can foresee difficulties in such a procedure, but the general discussion does get us somewhere. (1) It makes us a little less pedantic about mere amplifiers, and (2) it indicates the general road along which we must travel in the quest of better sound.

It might help explain also some of the elusive differences, noticed between amplifier set-ups, which are ostensibly identical. Perchance the lack of clarity is partly the result of confused echoes in the listening room. Perchance the deep, smooth bass is a fortunate combination of speaker and room resonance.

Think about it, a while!

"KARSET" FOR 1952

(Continued from Page 63)

may produce just the opposite result in another part. Similarly, such treatment can be frequency-conscious, that is, removal of interference at one part of the tuning range can, sometimes, increase it over another portion of the range.

However, if you have followed the technique outlined in this article, you should not have much trouble in this respect. One point worth mentioning is that the LT ignition filter choke mounted at the power plug of the set and intended to reduce ignition interference being fed into the set via the incoming 6-volt lead from the accumulator can, in some cases, actually increase "hash interference from the vibrator supply. You can check this by shorting it out temporarily.

Another point is that bypassing the set side of this choke with the .1 mfd returned to the earth point at the base of the plug bracket rather than to a point along the chassis side may prove better in some cases.

We noticed that with the converter grid circuit temporarily shorted, there was a very small amount of low frequency hum and a slight trace of "hash" in the audio section. It was low enough, however, as not to be noticed above the normal set noise with the aerial attached. It can be virtually removed by placing an 8 mfd electrolytic from the HT line of the set to the chassis. There is room for a miniature 8 mfd on the chassis underside below the volume control.

Incidentally, the June 1949, issue of Radio and Hobbies carried a lengthy article on the installation of a car radio, dealing in the main with aerial types, the fitting of the radio into position and the elimination of ignition interference. We may be able to summarise the article for new readers in the next issue.

PROCESSING YOUR BROMIDE PRINTS

(Continued from Page 97)

haustion, type of paper, etc., and providing the exposure is correct, is capable of very accurate results.

The last requirement, correct exposure, is, unfortunately, the "catch," for until we have correctly developed a test strip we do not know the correct exposure, and we can't develop correctly until we can produce a correct exposure.

Nevertheless, many professional photographers work on this basis, sub-consciously perhaps, and obtain satisfactory results because they are able, from long experience, to estimate correct exposure.

Although rather unconventional, the writer is inclined to favor, for the beginner at least, some form of time-temperature chart or graph.

If we can assume that the "slope" of a time-temperature graph is substantially a function of the developer (and this assumption seems fairly correct, see Radio & Hobbies, May, 1951), then there seems no reason why the known slope of a particular developer should not be shifted to suit a printing paper.

MAKING A GRAPH

One of the most popular print developers is the well-known Kodak D-72 formula, and this is also sold in powder form under the name of Dektol, the latter being described by the makers as an improved form of the D-72 formula. The slope of this developer is available in the Kodak Processing and Formulae Data Book, while the print developing time is given with the developer—and in the Kodak Bromide Paper Data Book—as two minutes at 68 degrees.

Combining this information, we can produce a time-temperature graph for bromide papers, and one such, made in our own drawing office, is reproduced for the guidance of beginners. Prints made over a wide range of temperatures, in accordance with this information, support the soundness of the scheme.

At the same time, it is not advisable to carry this idea of temperature compensation too far and below 55 degrees many developers cannot be relied upon to follow the same law as they do at higher temperatures. Above 75 degrees there is a danger that the emulsion will be softened and will frill around the edges of the print, although the writer has worked at 80 degrees without any sign of such troubles.

EXHAUSTION

The 55 degree limit is not a serious hardship, since it is quite permissible to use a radiator in the darkroom when handling bromide paper, the red glow being quite safe. In any case you will probably need some kind of heating for your personal comfort if the temperature is around this figure. There are other ways in which the developer may be kept at higher temperatures, such as heating plates on which the trays may be placed, or larger trays containing warm water in which the working tray may be placed.

Another factor contributing to incorrect development is the exhaustion of the developer, and it is most important to know just how many prints of a certain size can be processed in a given amount of solution. In some cases this information is available from the makers, while, in others, you will have to determine it for yourself. Where it is specified, usually as so many square inches of print area per pint, it is advisable to convert this to a table showing the number of prints, of your favorite size, which can be processed by the quantity you normally make up.

When this information is not available, you can make a fair estimate from the following procedure: Having determined the correct exposure for the first print to be processed, note carefully the first appearance time as this print is being developed. Subsequent prints (not test strips) should have the same first appearance time until the activity of the developer begins to fall off, when longer times will be noted.

KEEPING PROPERTIES

It is possible to compensate for exhaustion by longer development, but only within narrow limits, and it is much cheaper to discard the developer than to spoil a print.

When totalling up the amount of paper which has passed through the bath don't forget the test strips, which can easily added up to a couple of sheets of paper and spoil your calculation if neglected. When uiing Dektol, the writer prefers to limit the paper to 40 square inches per ounce, assuming that it is mixed on the recommended 4 to 1 ratio. It may be possible to get greater life than this, but it will certainly entail progressively increased development times—with all its attendant problems.

There is also the question of deterioration of the developer due to storage. Fortunately this is not a serious problem with modern, well designed, formulas and the writer has stored Dektol in a full, tightly-stoppered bottle, for over 12 monhs without any measurable change in quality or speed of working. Prints made with it could not be detected from similar prints processed in a freshly mixed solution and required the same exposure and development times.

Nevertheless, the makers would hardly claim this life, and it is asking rather much of any solution. A more normal like to expect would be three months and every effort should be made to keep your stocks down to a quantity which will be used in approximately this time. The solution referred to above, while quite fresh when the bottle was first opened, deteriorated much more rapidly than usual when once the air was admitted.

STORE PRECAUTIONS

The condition of a solution can usually be judged by the color, a clear mixture being in good condition, while one which has deteriorated will be dark brown. Deterioration becomes more rapid as the quantity of air in the bottle increases and it is unwise to store solutions for more than a few days in bottles which are less than half full. It is a good idea, once about a quarter of the contents have been used, to re-bottle the remainder into smaller bottles which can be completely filled.

Wanted to Buy, Sell or Exchange

SELL: AWA Junior Sig. Gen., nearly new, £55. Turntable and Crystal PU in leathercloth case, £9. ½ kva HT Transformer, 900v per side, £4. **JJ2176.**

FOR SALE: Movie Camera for 9.5mm Will work under any conditions. New, £50, with two loaders and carrying case. Apply **B. C. Bell, Milton 6C.**

FOR SALE: One new Ferris Electric Train, transformer included. Work on 240 volts. With lines and three cars. Button reverse unit. Outstanding offer. £15. **P. Gatehouse, Milton.**

FOR SALE: 1 Phillips office call system with 3 speakers and microphone. Good condition. **Properts Pty. Ltd., 73 King St., Newtown. LA5011.**

FOR SALE: Wide World, Popular Science, Popular Mechanics, National Geographic, Apr. and R. & H. Magazines, in first class order. **35 Merriwa St., Katoomba, NSW.**

FOR SALE: AR8 Receiver. Good order, £20. **Vine Hall, 18 McHatton St., North Sydney, XB2326.**

FOR SALE: Eddystone 640 receiver in excellent condition, £55. Apply **R. Guthberlet, PO Box 73, Port Pirie.**

FOR SALE: 2JU Communications Five short-wave receiver—Eddystone dial, bandspread, BFO, AVC. — Front Panel Speaker, Plug-in Coils. Excellent appearance and performance, as new, £25. **L. F Seager, c/- "Roseville," Clare St., New Town, Hobart, Tas.**

SALE: Philips TA101B Sig Gen., £30. AWA BFO, £40. Palec VCTV Tubechecker M'meter, £20. AWA Marine Rec., £15. **Donaldson, Robinson Rd., Geebung, Brisbane.**

SELL: Bendix Radio Compass, Taylor Junior Multimeter, Veler Speaker, Flare, 12" Rola Speaker, Earphones, Morse Key Buzzer. Assorted Valves and parts, R. & H. **Crouch, 35 Mona St., Auburn.**

SELL: National HRO complete with power supply, speaker and all coils 180 kc/s to 30 mc/s. **6 Gore St., Arncliffe.**

SELL: No. 11 Set complete in carrier, £6. No. 11 Set complete less HP unit and carrier, £4. Freight forward. **D. McIntosh, Myrtleford, Vic.**

SELL: Goodmans Axiom 12, little used, good order, £12. **H. L. Smith, Box 60, Horsham, Vic.**

SELL: 1R5, 2—1T4, 1S5, 3S4, 10/- each; Midget 3-gang, 7/6; Loop Aer., Midget RF Osc. and IF's, 25/-; 3" Speaker, 10/-; 150 mA Trans., £3½, 884 and 902, £1; 2 2-gang H, 10/- each; 3 H Dials, 12/6 each; 807 10-watt amp kit, £7½, less speaker; 2 Ex. Disp. TX var. cond., 4 .05 x 16 kv fixed cond., Trans. 240 pri.—22.5v sec. at 22 amps. Best offer Spkr. Trans., 7/6 ea.; Car Radio, 6v, 6-valve, £25. Coils, Aer., Osc. and IF's, £1. **4 Calypso Av., Mosman.**

SELL: Mantel Radio, EK32, EBF26, 6V6, 6X5, Bakelite cabinet, £10. Portable radio, 1R5, 1T4, 1S5, 3V4. Plastic case, new batts., £18½. Both sets good order, also assortment parts, valves, trans., speaker, condensers, etc., worth over £6, sell for £3½. **178 Rose St., Fitzroy, Victoria.**

SELL: Palec VCT University Mod. Osc., Wireless Sets, Speakers, Valves, Transformers, various radio equipment. Full list on application. **W. H. Crummer, 21 Wood St., West End, Brisbane.**

SELL: R. & H., 1943, Mar., July, Aug., Sept., Nov., Dec. 1944, Feb., Mar., Apr., July, Sept., Nov., Dec. 1945, C'plete. 1946, C'plete. 1947, all but Dec. 1948, Jan., Feb., Mar. **Eades, 14 Dreadnought St., Lakemba.**

WANTED: R. & H., June, 1951. State price. **Phone BW8350.**

WANTED TO EXCHANGE: No. 19 Transceiver. Complete Air Tested. Reliable, for good used typewriter. Must be good order. Cash adjustment if necessary. **Laycock Radio Service, Barton St., Cobar, NSW**

WANTED: Hallicrafters model S39. Any condition. **Gerry van Leuven, 2nd Av., Naracoorte, SA.**

EXCHANGE: Palec Portable Electronic Flash Unit, new and complete, for AR7 with coils, or sell, £40. Eddystone full-vision dial and Jenson 5" PM Speaker for 18 swg enamelled wire. **W. C. Branchett, c/- Lowe's Pharmacy, Watton St., Werribee, Vic.**

THEORY ON COSMIC RAYS

EVIDENCE that cosmic rays, ceaselessly bombarding the earth from outer space with tremendous energies, come from the sun has been put forth.

From studies of the abundance of light elements in cosmic rays, Dr. Bernard Peters and the late Dr. H L. Bradt, while at the University of Rochester, New York, concluded that the rays probably do not come from outside our own solar system.

Primary cosmic rays, beating down on the earth's atmosphere, smash into atoms high in the upper air, forming in these collisions many different kinds of particles, protons, mesons and neutrons. Their energies are many times greater than those available in man-made accelerators. By studying these mysterious rays and the atomic havoc they cause, scientists expect to learn how and why the atom is held together.

The scientists state that the absence or scarcity of lithium, beryllium and boron in primary cosmic rays indicates that the chemical composition at their source is similar to the average for the universe. On this basis they argue in favor of solar origin, or, at least, in favor of a source region close enough to the earth to reflect the chemical abundance ratio at cosmic ray origin without need for an accelerating mechanism between the source and earth.

In doing so, they disagree with two current theories on the origin of cosmic rays.

Dr. Enrico Fermi of the University of Chicago has proposed that cosmic ray particles come from within our galaxy and that they attain their great speed by collisions within this galaxy with moving magnetic fields varying in degree.

Dr. Lyman Spitzer jun., director of Princeton University Observatory, has assumed that cosmic ray particles were accelerated as dust grains by radiation pressure in the vicinity of supernova, giant exploding stars that flare up suddenly to many times their usual brilliance.

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